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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstract 16062.

15781 NUCLEAR METHODS IN AIR AND WATER POLLUTION ANALYSIS. Iddings, Frank A. (Louisiana State Univ., Baton Rouge). Environ. Sci. Technol., 3: 132-40(Feb. 1969).

Advantages and disadvantages of several nuclear methods as applied to air and water pollution analysis are discussed. Techniques involving isotope dilution, radiorelease, radiometric titration, radiation absorption, activation and radioisotope derivative analyses, as well as standard analytical methods using tracers, are discussed. (J.G.B.)

15782 LEVELS OF STABLE STRONTIUM IN MILK AND THE TOTAL DIET. Rehnberg, Georgia L.; Strong, Ann B.; Porter, Charles R.; Carter, Melvin W. (Southeastern Radiological Health Lab., Montgomery, Ala.). Environ. Sci. Technol., 3: 171-3(Feb. 1969).

Samples of pasteurized milk, composite total diet, and various other environmental media were analyzed for stable strontium, calcium, and strontium-90 during January through December 1965. These data are presented for use as reference material and interpreted with regard to significance of stable strontium levels. Pasteurized milk network samples from the southern United States, the Canal Zone, and Puerto Rico were analyzed. An average value of 0.86 ± 0.23 mg of Sr^{2+} per liter was obtained for the 20 sampling stations. Values ranged from 0.43 ± 0.03 mg per liter in Washington, D. C., to 1.51 ± 0.11 mg per liter in Cristobal, Canal Zone. Composite total diet samples from children's homes in the southern United States were also analyzed. Individual stable strontium values ranged from 0.49 ± 0.02 mg per kg in Charleston, S. C., to 1.96 ± 0.10 mg per kg in Oklahoma City, Okla., with an over-all average of 0.89 ± 0.18 mg per kg wet weight. (auth)

15783 USE OF X-RAY FLUORESCENCE IN TRACE ANALYSIS. III. DETERMINATION OF FOREIGN METAL TRACES IN HIGH-PURITY MOLYBDENUM AND TUNGSTEN AFTER ENRICHMENT BY PRECIPITATION WITH 1-(2-PYRIDYLAZO)-2-NAPHTHOL. Pueschel, R.; Lassner, E. (Metallwerk Plansee A. G., Reutte, Austria). J. Less-Common Metals, 17: 313-17(Mar. 1969). (In German).

A new, simple, and accurate method for the determination of trace impurities (Mn, Fe, Co, Ni, Cu, and Zn) in high-purity molybdenum and tungsten and their oxides is described. The method involves the concentration of the trace metals by their precipitation with 1-(2-pyridylazo)-2-naphthol (PAN), and their subsequent determination in the organic precipitate by means of X-ray fluorescence analysis. The limit of determination using a 1-g sample is 0.2-1-ppM, depending on the trace metal; the precision is about 10% within a range of 0–40 ppM. (auth)

15784 DETERMINATION OF GASES IN NEUTRON-IRRADIATED BERYLLIUM OXIDE BY GAS CHROMATOGRAPHY: HYDROGEN, TRITIUM, HELIUM, NITROGEN, OXYGEN, AND CARBON MONOXIDE. Morris, Anthony J.; Thackray, Malcolm (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Anal. Chem., 41: 467-70(Mar. 1969).

A method is described which allows the determination of helium, hydrogen, tritium, oxygen, nitrogen, and carbon monoxide in irradiated BeO. The BeO is dissolved in a mixture of sulfuric and phosphoric acids by refluxing in an atmosphere of carbon dioxide. The carbon dioxide is then frozen out and the residual gas is analyzed by gas chromatography and/or mass spectrometry. By the use of a delay line and a plastic scintillation detector, the tritium content of the hydrogen can be portrayed on the same chromatogram as the helium and hydrogen. Tritium remaining in the acid is determined by liquid scintillation counting. The ratio of free to combined tritium is approximately 1:10. (auth)

Chemical Procedures

Refer also to abstract 15962.

15785 (ANL-Trans-720) METHOD OF PRECISION GAS MASS-SPECTROMETRIC ANALYSIS OF THE ISOTOPE COMPOSITION OF Mo. Bantysh, A. N.; Knyazev, D. A. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Russian Patent 183,469. 3p. Dep. CFSTI.

A method for mass-spectrometric isotopic analysis of Mo, using MoO_2Cl_2 or $MoOCl_4$ as the working substances, is described. These oxychlorides are solids at normal temperatures and their decomposition under vacuum conditions is extremely slow. This permits a simple and smooth control of the flow during prolonged measurements under stable conditions and increases, therefore, the accuracy of the analysis. (M.C.G.)

15786 X-RAY-SPECTROGRAPHIC FLUORESCENT DETERMINATION OF ZIRCONIUM AND HAFNIUM. Il'in, N. P.; Kakhana, M. M. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim., 24: 199-204(Feb. 1969). (In Russian).

A method has been developed for the x-ray-spectrographic fluorescence determination of zirconium and hafnium in natural samples. The criterion of the analytical resolution of closely located lines, which was applied to the lines $HfL\beta_1 - ZrK\beta_{2,4}$ II is discussed. The sensitivity of the determinations is 0.01% for hafnium and 0.001% for zirconium, the reproducibility is 3 to 4%. (auth)

15787 DETERMINATION OF BERYLLIUM IN THE PRESENCE OF LARGE AMOUNTS OF URANIUM. Vinogradov, A. V.; Filippova, M. P. Zh. Anal. Khim., 24: 253-5(Feb. 1969). (In Russian).

A method has been developed that permits the determination of 1 mg of beryllium in the presence of 30 mg of uranium in 100 ml at the ammonium carbonate concentration of 0.5 M. In 200 ml of the solution the determination of the same amount of beryllium is possible in the presence of up to 60 mg of uranium at the same concentration of ammonium carbonate. The variation coefficient during the determination of 3 mg of beryllium is ±0.5%. (auth)

15788 THE SOURCES OF ERRORS OF THE VACUUM-FUSION METHOD DURING THE DETERMINATION OF OXYGEN IN NIOBIUM. Karpov, Yu. A.; Clavin, G. G.; Kunin, L. L. (State Scientific-Research and Design Inst. of the Rare-Metal Industry, Moscow). Zh. Anal. Khim., 24: 276-9(Feb. 1969). (In Russian).

The most essential errors of the vacuum-fusion method are due to the deviations of the blank value, due to the surface impurities and the errors of analysis of the extracted gases, due to the absorption of evolved gases by sorption-active sublimates and due to the incomplete extraction of gases from the sample.

The sensitivity of niobium analysis for oxygen is limited first of all by the incompleteness of its extraction from the sample. The intensive mixing of the melt favors the more complete evolution of oxygen. Electromagnetic mixing at the induction heating is not sufficiently effective, the use of metal cases increases the blank value. A more effective method for the melt mixing is necessary in order to increase the sensitivity of the oxygen determination in niobium. (auth)

15789 TITRIMETRIC DETERMINATION OF NIOBIUM WITH CUPFERRON IN THE PRESENCE OF METALLOCHROMIC INDICATORS. Babko, A. K.; Tselinskii, Yu. K. (All-Union Scientific-Research Inst. of Chemical Reagents and Chemically Pure Materials for Electron Techniques, Donetsk, USSR). Zh. Anal. Khim., 24: 259-61(Feb. 1969). (In Russian).

Conditions have been found for titrating niobium(V) with cupferron in aqueous-alcohol solutions at pH 2 to 3 in the presence of pyridylazo resorcinol. The effects of the organic solvent concentration, temperature, pH, hydroxy-acids, and foreign ions on niobium determination were studied. (auth)

15790 OSCILLOPOLAROGRAPHIC DETERMINATION OF CERTAIN RARE EARTH ELEMENTS IN ALLOYS BASED ON IRON, NICKEL, AND CHROMIUM. Novakovskaya, E. G.; Denisov, E. I.; Nadezhina, L. S. (Leningrad Polytechnical Inst.). Zh. Anal. Khim., 24: 257-9(Feb. 1969). (In Russian).

A method is suggested for the oscillopolarographic determination of cerium, europium, lanthanum, and the total rare earths in alloys based on iron, nickel, and chromium. The rare earths are separated by means of coprecipitation on thorium oxalate in the presence of Complexone III, then cerium and europium are polarographed in the presence of thorium. Lanthanum and the total (La, Ce, Nd) are determined after thorium has been extracted with CCl_4 as a complex with acetylacetone. The method permits the determination of 10^{-2} to 10^{-1}% of the rare earths with an accuracy of ±0.005 and ±0.03% correspondingly. (auth)

15791 GLYCINECRESOL RED AS A REAGENT FOR THE DETERMINATION OF SCANDIUM AND ZIRCONIUM. Tataev, O. A.; Beschetnova, E. T.; Yarysheva, E. A.; Guseinov, V. K. (Daghestan State Univ., Makhachkala, USSR). Zh. Anal. Khim., 24: 255-7(Feb. 1969). (In Russian).

Scandium and zirconium form colored compounds with Glycinecresol Red (GCR)—3,3′-di-(N-carboxymethylaminomethyl)-o-cresolsulfophthalein—at pH 4.5 to 5.5 in an acetate medium. Scandium interacts with GCR at a molar ratio of 1:3, zirconium at a ratio of 1:2. The maximum absorption of scandium and zirconium complexes is correspondingly at 490 and 520 nm, their molar extinction coefficients are 21,000 and 15,000, the instability constants are 4.73×10^{-28} and 3.5×10^{13}, the lower determinable amounts are 9.48×10^{-7} and 1.4×10^{-6} g-ion/liter. Silver, zinc, cadmium, large amounts of magnesium, manganese, and other elements do not interfere in the photometric determination of scandium and zirconium. (auth)

15792 COLORIMETRIC DETERMINATION OF BERYLLIUM IN COPPER–BERYLLIUM ALLOYS. Cioaca, Emilia. Cercet. Met., 9: 693-8(1967). (In Rumanian).

A method was developed for the photometric determination of beryllium in beryllium bronzes. The method consists in the formation of colored complexes between beryllium and Chromazurol S, in which sodium thiosulfate and Trilon are used to complex interfering elements. The error of the method is <3.5%. (auth)

15793 METHOD FOR THE PHOTOMETRIC DETERMINATION OF CERIUM CONTENT IN STEEL. Nicolescu, Luciana; Morait, Margareta; Mustacescu, Erika. Cercet. Met., 9: 361-5 (1967). (In Rumanian).

The method is based on acid dissolution of the sample, removal of the iron and other elements in steel by mercury cathode electrolysis, and photometric determination of cerium as a peroxidic complex (auth)

15794 CHROME AZUROL S AS A SPECTROPHOTOMETRIC REAGENT FOR THE DETERMINATION OF RUTHENIUM AND RHODIUM. Saxena, Krishna K.; Dey, Arun K. (Univ. of Allahabad, India). Indian J. Chem., 7: 75-6(Jan. 1969).

The use of Chrome Azurol S for spectrophotometric determination of ruthenium and rhodium was recommended. The regions of maximum absorption of the complexes of Ru and Rh lie at 540 and 570 mμ respectively and that of CAS at 490 mμ (at pH 4.0). The sensitivity indices of color reactions are 0.02 and 0.008 $\mu g/cm^2$ respectively for the two ions. About 45 to 90 min heating is required for the color to attain full intensity and the optimum concentration for accurate spectrophotometric determination is 0.45 to 7.0 and 0.7 to 7.0 ppM for ruthenium and rhodium, respectively. The suitable pH ranges are 3.5 to 4.5 (for Ru) and 3.5 to 5.0 (for Rh). The interferences due to other associated metals were studied. (auth)

15795 ARSENATE–IODIMETRIC DETERMINATION OF HAFNIUM. Mamedov, I. A.; Rasulbekova, R. A. Uch. Zap. Azerb. Gos. Univ., Ser. Khim. Nauk, No. 2, 19-23(1967). (In Russian).

A method for determination of Hf is based on the precipitation and separation of the Hf as $Hf(HAsO_4)_2$ with dissolution of the precipitate in acid and titration of the iodine liberated by the reaction of the arsenate with KI solution. The Hf (1 to 70 mg) from a 2 ml test solution is precipitated by addition of 10% aqueous NH_3 to produce turbidity, then addition of 6 to 10 ml of 1:1 HNO_3 or HCl or 3 to 5 ml of 1:1 H_2SO_4, heating to boiling, and finally the addition of 20 ml of a slightly acidified hot 10% Na_2AsO_4 solution. The pricipitate is collected, washed 8 to 10 times with hot H_2O and heated along with the filter with 25 to 30 ml of H_2SO_4 (2:5). Twenty ml of benzene and 3 ml of 2N KI are added to the cooled solution, and the mixture is shaken. An equal volume of H_2O is added, and the liberated iodine is titrated with 0.1N $Na_2S_2O_3$ with vigorous shaking until the organic layer is colorless. There is no interference in the precipitation from Mg, Ca, Ba, Be, Al, Fe(III), Mn(II), Zn, Co, Ni, Cd, Cu(II), Th, Ti, La, Nd, Pr, V(V), Mo(VI), Cr(III), or Cr(VI). In the presence of PO_4^{3-}, the $Hf(HAsO_4)_2$ must be reprecipitated. A determination takes 25 to 30 min. (Referativnyi Zh.)

15796 SPECTROPHOTOMETRIC DETERMINATION OF BORON IN U_3O_8 WITH METHYLENE BLUE. Onishi, Hiroshi; Nagai, Hitoshi (Japan Atomic Energy Research Inst., Ibaraki). Bunseki Kagaku, 18: 164-8(Feb. 1969). (In Japanese).

A spectrophotometric method is described for the determination of 0.2 to 1 ppM of boron in U_3O_8. The sample (1 g) is dissolved by heating with sulfuric acid and hydrogen peroxide. Hydrofluoric acid is added to form tetrafluoroborate ion. Methylene Blue solution is then added, and Methylene Blue tetrafluoroborate is extracted with 1,2-dichloroethane. The organic phase is washed with water to remove the excess dye. The absorbance of the washed organic phase is measured in a 1-cm cell at 660 mμ. Correction is applied for small amounts of interfering elements (tantalum, etc.) by evaporating the sample solution with hydrofluoric acid (boron is volatilized), adding hydrofluoric acid and Methylene Blue, and extracting with 1,2-dichloroethane. Six analyses of U_3O_8 containing 0.5 ppM of boron gave a relative standard deviation of 3.2%. The proposed method was successfully applied to several standard U_3O_8 samples and a standard uranium metal. The metal was converted into U_3O_8 by igniting at a low temperature and heating at about 800°C for 1 hour. (auth)

15797 DETERMINATION OF MOLYBDENUM IN STEELS BY HIGH-FREQUENCY PLASMA TORCH SPECTROMETRY. Suzuki, Mitsuyasu (Tohoku Univ., Sendai). Bunseki Kagaku, 18: 176-9(Feb. 1969). (In Japanese).

In order to determine molybdenum in steels by high-frequency plasma torch spectrometry, experimental conditions were examined. The most suitable conditions were as follows; magnetron anode current 140 mA, argon gas as the carrier 5.4 l/min, and analytical line Mo I 3864.11 Å. Iron, nickel, chromium, vanadium, copper, bismuth, and tungsten did not influence on the intensity of analytical line. The calibration curve had good linearity. Molybdenum in steels could be determined rapidly with high precision, the coefficient of variation being about 3.3%. (auth)

15798 SEPARATION OF URANIUM AND VANADIUM AND THEIR DETERMINATION IN PHOSPHATE ROCKS. Li, Hsiang-chi; Chung, Shih-chiang; T'ien, Kuo-hsing. Acta Scient. Natur. Scholar. Super. Sinens., Chim. Chim.-Tech., 1: No. 1, 1-5(1966). (In Chinese).

A solution of analyzed sample is passed through a column filled with a strongly basic anionite in Cl-form. A portion of the filtrate is used for photometric determination of V. U and Fe, sorbed with resin, are washed off with 1M HCl solution. The eluate is evaporated to dryness, the residue is dissolved in concentrated HNO_3 and the solution is again evaporated to dryness. To the residue are added 1.6M Al $(NO_3)_3$ in 0.3M HNO_3, and the solution obtained is passed through a second column containing 4 g of strongly basic resin preliminarily reduced to NO_3-form. The column is washed with 1.6M Al $(NO_3)_3$ solution and 8M HCl solution (to remove Al^{3+}) and U is eluted with 1M HCl solution. The eluate is evaporated to dryness; to the residue is added a solution of the background (0.5M H_2SO_4 + 0.5M $H_2C_2O_4$) and 0.15% gelatin solution, and U is determined polarographically. (JPRS)

15799 SPECTROGRAPHIC DETERMINATION OF METALLIC IMPURITIES IN YTTRIUM USING A SIFTER TYPE ELECTRODE.

Kaneko, Keiji; Goseki, Shoichi (Electrotechnical Lab., Tokyo). Bunseki Kagaku, 18: 220-5(Feb. 1969). (In Japanese).

An oxide-direct current excitation method using a sifter type electrode and ammonium bifluoride buffer was applied successfully to the spectrographic determination of B, Fe, Mg, Mn, P, Pb, and Sn in yttrium metals and oxides. Series of standards covering 0.1 to 100 and 1 to 1,000 ppM of the impurities each in four steps (e.g., 0.1, 0.3, 0.7, and 1.0 ppM) were prepared by diluting measured quantities of base materials with weighed quantities (1 to 5 g) of spectroscopically pure yttrium oxides. Every base material was prepared to adding dropwise each standard solution (1 mg/ml) containing the impurity on spectroscopically pure yttrium oxide in a platinum crucible. It was dried on a hot plate, ignited in a muffle furnace at 800°C for 3 hours, and ground in an agate mortar. The samples were treated in exactly the same manner as the base materials. The spectrographic conditions are as follows: amounts of the oxide 50 mg, Shimadzu-Littrow type spectrograph, excitation voltage dc 200 V, arc current 10 amp., slit width 15 μ, and duration of exposure 40 sec. Variation coefficients for 0.1 to 1,000 ppM of impurities in yttrium are within 20%. (auth)

15800 ON THE DETERMINATION OF ZIRCONIUM IN TUNGSTEN STEELS BY CUPFERRONCHLOROFORM EXTRACTION AND XYLENOL ORANGE EXTINCTION PHOTOMETRY. Kamakuru, Masataka; Sawada, Takahiro. Tetsu To Hagane, 54: No. 10, 296(Aug. 1968). (In Japanese).

The cupferron–chloroform extraction process was modified by the addition of tartaric acid to separate Zr and W for determination of Zr in W steels. The Zr is determined by extinction photometry of the colored complex formed with xylenol orange. (TSS)

15801 ON THE ANALYSIS OF Ti(C,N) AND Zr(C,N) BY A MICRO-ANALYZER. Shiroiwa, Toshio; Fujino, M. Tetsu To Hagane, 54: No. 10, 268(Aug. 1968). (In Japanese).

For a variety of the steels, the amounts of carbon and nitrogen in the produced Ti(C,N) were determined semiquantitatively, and compared with the carbide of zirconium. The Ti(C,N) is classified as two materials: one with a nuclear structure; and the Ti(C,N) solid solution. In the case of nuclear structure, the center is TiN with some dissolved carbon, surrounded by a carbide. For the Ti(C,N) solid solution, it is nearly all pure TiN, the amount of dissolved carbon increasing with the carbon in the steel. In the steels with zirconium, ZrN, ZrC, and the Zr(C,N) having a nuclear structure coexist in the same sample. (NSA of Japan)

15802 8-QUINOLINOL EXTRACTION AND SPECTROPHOTOMETRIC DETERMINATION OF URANIUM WITH ARSENAZO III. Motojima, Kenji; Yamamoto, Tadashi; Kato, Yoshiharu (Japan Atomic Energy Research Inst., Ibaraki). Bunseki Kagaku, 18: 208-13(Feb. 1969). (In Japanese).

A study was made on the method for sensitive and rapid photometric determination of uranium with Arsenazo III. Uranium(VI) forms Arsenazo III complex in 5 M perchloric acid. It has an absorption maximum at 655 mμ; the molar absorptivity is ca. 7.1×10^4, and Beer's law holds over the range of 0 to 2.0 μg U/ml. Zirconium, thorium, and rare earth elements also form the complexes with Arsenazo III in the acidic solution, which interfere with the determination of uranium. Uranium, however, can be separated from the elements by 8-quinolinol extraction method. Uranium is extracted with chloroform as 8-quinolinolate from the solution whose pH was adjusted to 6.0 to 6.5, after masking the interfering elements by an addition of EDTA. Uranium is back-extracted with a definite volume of 0.02% Arsenazo III–5 M perchloric acid solution. The absorbance of the aqueous phase is measured at 660 mμ. In this case, the absorption maximum shifts to 660 mμ and the molar absorptivity is ca. 6.7×10^4. (auth)

15803 CHELATOMETRIC SCANDIUM DETERMINATION IN THE PRESENCE OF OTHER ELEMENTS. Patrovsky, V. (Geologisches Zentralinstitut, Prague). Collect. Czech. Chem. Commun., 33: 3892-4(Nov. 1968). (In German).

It was found that scandium can be chelatometrically titrated in the pH region of 3 to 4 in the presence of several elements if they are masked with tartaric acid or reduced to lower valence states (Fe, V, Cr) with ascorbic acid. Al, Ga, Ti, Sn, Sb, W, Mo, Be, Zr, U, and Cr were masked by the tartaric acid. Ascorbic acid reduced vanadate, chromate, and iron salts. Th, Bi, In, Y, and Pb disturbed the determination. (M.C.G.)

15804 INVESTIGATION OF THE REACTIONS OF LEAD(IV) ACETATES WITH PEROXIDE SUBSTANCES. Borecky, O.; Zyka, J. (Univ., Prague). Collect. Czech. Chem. Commun., 33: 3463-9(Nov. 1968). (In German).

The reactions of peroxide materials with lead acetate were investigated and conditions were found under which they proceed quantitatively. This can be used for volumetric determination under potentiometric control. Perborates, as well as hydrogen, sodium, magnesium, and barium peroxides were determined. The method was also used for determination of uranium peroxide in hydrogen peroxide–peroxyacetic acid mixtures. (tr-auth)

15805 MASS SPECTROMETRY. Rinehart, Kenneth L. Jr. (Univ. of Illinois, Urbana); Kinstle, Thomas H. Annu. Rev. Phys. Chem., 19: 301-42(1968).

Topics discussed include: high-resolution mass spectrometry and data reduction, other instrumental aspects, fragmentation and structure of positive ions, applications to organic and inorganic chemistry, applications to natural products, applications to biochemistry, applications to organic geochemistry and cosmochemistry, and ion–molecule reactions. (582 references). (M.C.G.)

15806 APPARATUS FOR MEASURING GAS RELEASE OF CERAMIC NUCLEAR FUEL MATERIALS AT HIGH TEMPERATURES. Burt, Merrill C. (Battelle-Northwest, Richland, Wash.). Anal. Chem., 41: 549-51(Mar. 1969).

A vacuum extraction apparatus designed for the measurement of the gas release of fuel materials at various stages in the fabrication process is described. Since the equipment must handle extremely toxic materials, such as plutonium, it was necessary to build part of the apparatus in a glove box. The precision of the method and the equipment was established by analyses of a uniform batch of UO_2 powder at 1400°C. Analysis of eleven samples with a mean gas release of 0.70 ml/g indicated a relative standard deviation of 7.1%. The analysis of unalloyed titanium samples for hydrogen resulted in an average relative error of 5.2%. (D.H.M.)

Isotopic Procedures

15807 (CU-3139-2, App.F) RADIUM DETERMINATION IN SEA WATER BY ISOTOPE DILUTION. Wolgemuth, Kenneth M. (Columbia Univ., Palisades, N. Y. Lamont-Doherty Geological Observatory). 5p.

As part of a project to find variations in the ratio of $^{226}Ra/Ba$ in seawater, a new technique is being devised to determine ^{226}Ra with greater accuracy. This technique involves the addition of ^{228}Ra tracer, and decay curve analysis of successive beta counts. (auth)

15808 RADIOCHEMICAL SEPARATION OF BISMUTH ACTIVITIES USING DALZIN, AND ITS APPLICATION TO GEOLOGICAL PROBLEMS. Rao, B. L.; Parekh, P. P.; Das, M. Sankar (Bhabha Atomic Research Centre, Bombay). J. Radioanal. Chem., 2: 79-89(Jan. 1969).

A radiochemical method was devised for the separation of bismuth activities of the natural series, viz. ^{214}Bi, ^{210}Bi, and ^{212}Bi, and applied to the indirect estimation of their corresponding precursors, ^{222}Rn, ^{210}Pb, and ^{212}Pb, in a wide variety of geological materials. The method consists of the solvent extraction of bismuth in radiochemically pure form from the sample solution at pH 2 with diallyldithiocarbamido-hydrazine (Dalzin) in chloroform, and back extraction with 2M acid. The advantages of this method over the dithizone extraction system are discussed. (auth)

15809 RADIOACTIVE KRYPTONATES IN VOLUMETRIC ANALYSIS. PART 7. APPLICATION OF THE RADIOACTIVE KRYPTONATE OF GLASS AS THE INDICATOR OF END-POINT IN PRECIPITATION TITRATION. Toelgyessy, J.; Siles, B.; Jesenak, V.; Varga, S. (Slowakische Technische Hochschule, Bratislava). Isotopenpraxis, 4: 383-5(Oct. 1968). (In German).

A method of determining cations by precipitation titration was developed by using radioactive kryptonate of glass as the indicator of end point. Applying this technique, Cd^{2+} and Ca^{2+} were determined by titration with 0.1M NaF as the titrant. After passing through the end point, an equivalent fraction of ^{85}Kr is liberated by chemical destruction of the glass surface by titrant excess, and the radioactivity of the glass will decrease. The titration is discontinuous, i.e., the residual activity of glass kryptonate is measured. (auth)

Radiometric Procedures

Refer also to abstracts 16100, 16122, and 16222.

15810 (CEA-R-3653) DETERMINATION OF ^{90}Sr IN MILK ASH. Ballada, Jean; Jeanmaire, Lucien (Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires). Dec. 1968. 11p. (In French). Dep.

A method for determination of ^{90}Sr in milk ashes by extraction

of ^{90}Y in TBP is described. The tests that led to the choice of the operating process are presented together with the result of an intercomparison. (auth)

15811 (CU-3139-2, App.C) RADIOCHEMICAL STUDIES ON MANGANESE NODULES OF DEEP-SEA ORIGIN. Ku, Teh-Lung; Broecker, Wallace S. (Columbia Univ., Palisades, N. Y. Lamont-Doherty Geological Observatory). 57p.

Manganese nodules from different parts of the ocean floor were analyzed for their U, Th, Pa, and Ra contents. The results allow the following conclusions to be drawn: the uranium : thorium ratio in nodules is quite variable, and is 3 to 6 orders of magnitude lower than that in seawater. Uranium concentrations range from 4 to 13 ppM, with most values falling between 6 and 10 ppM. Thorium concentrations have a much wider spread (3 to 150 ppM) and show both a geographic and depth dependence. The ^{230}Th and ^{231}Pa in outermost layers of a nodule are greatly in excess over the amounts supportable by the uranium present. The decrease with depth of these two isotopes allow the growth rates of the nodules to be determined. Rates for the seventeen specimens deduced in this way vary from 1 to 6 mm/10^6 y; the majority of rates fall within the rather narrow limits of 2.5 to 4 mm/10^6 y. The ^{230}Th:^{231}Pa ratios at the nodule surface are considerably smaller than that predicted from the production of these two nuclides by the uranium dissolved in the ocean. Whereas an activity ratio of 11 is predicted, values as low as 2.4 were observed. Since ^{230}Th:^{231}Pa ratios considerably greater than 11 are found at the tops of deep-sea sediment cores, separation of the two species must occur during the sedimentary process. The distribution of ^{230}Th and ^{231}Pa on the surface of a given nodule is not uniform. Higher concentrations occur on the upper than on the lower sides. This suggests that precipitation of these nuclides occurs only on those portions of the nodule in contact with seawater. Measurements of ^{226}Ra reinforce the conclusion that this element migrates in sedimentary deposits. On a world ocean basis the amount of ^{230}Th and ^{231}Pa in manganese nodule deposits is probably no more than 5% of that generated by the uranium dissolved in the sea. (auth)

15812 (KURRI-TR-3) RADIOCHEMICAL STUDIES ON THE SURFACE CONTAMINATION OF THE "KUR" FUEL. Iwata, Shiro; Nishikawa, Sataro; Akahoshi, Mitsuhiko; Kiso, Yoshiyuki; Tanaka, Aiko; Waki, Asako; Sasajima, Kazuhisa; Matsushita, Rokuharu; Kotaka, Hisao (Kyoto Univ. (Japan). Research Reactor Inst.). [1965]. 14p. (In Japanese). Dep.

A study was made to determine the degree of surface contamination of the KUR (Kyoto University Reactor) fuel elements by the fuel (^{235}U) and to check for leakage of fuel through the cladding. The primary coolant water was sampled after operation of the reactor for a given period at a fixed output, and the radioactive iodine fission product was used as an indicator of the degree of surface contamination; changes in the radioiodine content after a given period of operation indicated the leakage rate through the cladding. The presence of fission-product iodine was determined by extraction with CCl_4, followed by spectrophotometric identification. Repeated oxidation and reduction steps were carried out, using NaI and $NaIO_3$ as carrier; a 90% iodine recovery yield was obtained by distillation. The 0.53-MeV photopeak of ^{133}I was used for the quantitative determination. The results indicated surface contamination of the order of 1 μg $^{235}U/ft^2$ of fuel plate. Followup studies after five months revealed that the detectable amount of fission products in the coolant water decreased gradually. This decrease was taken to indicate that the fission products were due to surface contamination and not to leakage through the cladding. (TTT)

15813 CATALYTIC EXCHANGE METHOD FOR LOW-LEVEL TRITIUM MEASUREMENTS IN WATER. Calf, G. E. (Australian Atomic Energy Commission Research Establishment, Sutherland). Int. J. Appl. Radiat. Isotop., 20: 177-85 (Mar. 1969).

Catalytic hydrogen exchange was used to label benzene, toluene, ortho-xylene, or para-xylene with tritium from natural water samples. These aromatic hydrocarbons can then be counted in a liquid scintillation system for the routine determination of the tritium content of the water. This procedure permits tritium measurement of rain without the need for isotope-enrichment techniques. The advantages of this procedure over other well-known methods of assay are discussed. (auth) (UK)

15814 INVESTIGATION OF URANIUM CONTENT AND DISTRIBUTION IN ULTRA-BASIC AND BASIC ROCKS BY RECORDING TECHNIQUE OF INDUCED URANIUM FISSION FRAGMENT TRACKS. Komarov, A. N.; Skovorodkin, N. V. (Inst. of Geology and Geochronology of the Precambrian, Leningrad). Geokhimiya, No. 2, 170-6(Feb. 1969). (In Russian).

Uranium content was determined in powdered ultrabasic rock samples from the Kola Peninsula by counting fragments of induced uranium fission in a dielectric detector. Analysis of radiographs on the fission fragments indicated that the higher the total uranium content in the rock, the greater part of uranium is restricted to areas which have altered owing to autometamorphism and superposed processes. (auth)

15815 DETERMINATION OF SMALL AMOUNTS OF HAFNIUM IN ZIRCONIUM ALLOYS BY FLUORESCENT X-RAY SPECTROSCOPY. Ohno, Katsumi; Matano, Nobuhisa (National Research Inst. for Metals, Tokyo). Bunseki Kagaku, 18: 213-19(Feb. 1969). (In Japanese).

The analytical conditions in fluorescent x-ray determination of small amounts of hafnium in zirconium alloys were examined. The best result was obtained by using HfL_β as the analytical line and an x-ray tube with gold target. The interference from ZrK line was removed by a yttrium filter, giving the best result with the combined use of a pulse-height analyser. The limit of detection of Hf was ca. 7 ppM. The standard deviation of the results of determination of 50 to 500 ppM Hf in zirconium alloys was 5 ppM. The relation of the sort of target metals in the x-ray tube and the limit of detection of hafnium, together with the limit of detection and the error in the calibration line, was also examined. (auth)

15816 RADIATION DOSE ESTIMATION IN CRITICALITY ACCIDENT. 3. A RAPID ESTIMATION OF FAST-NEUTRON DOSE BY HUMAN HAIR AND NAIL. Maruyama, Takashi (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 27: 1354-60(Jan. 1968). (In Japanese).

In case of accidental neutron releases, a rapid fast-neutron dose estimation is required for an appropriate medical treatment to the victims. By modifying the Peterson method, a procedure is proposed to measure rapidly the induced ^{32}P activity arising from the $^{32}S(n,p)^{32}P$ reaction in human hair or nail. The sulfur and phosphorus content of hair or nail of the Japanese tested was 43.7 ± 4.6 mg/g and 0.171 ± 0.024 mg/g, respectively. The activity in these samples can be measured by a coincidence type low background β ray spectrometer after incinerating without any chemical procedure. The procedure is very rapid comparing with the Peterson method and only 3 hours are required to estimate 20 rads of neutrons with energies in excess of 2.5 MeV using 0.1 g of hair or nail. (NSA of Japan)

15817 A METHOD OF MEASUREMENT OF THE URANIUM CONTENT OF A SOLUTION BY GAMMA-RAY SPECTROMETRY. Bourseau, Roland; Zini, Edmond (to Commissariat a l'Energie Atomique). British Patent 1,143,846. Feb. 26, 1969. Priority date Feb. 18, 1966, France.

A method was developed for determining trace amounts of uranium in solutions such as effluents from chemical plants for the concentration of ores. The daughter elements of uranium and/or thorium and its radioactive daughters are separated from the solution by coprecipitation with a fluoride or phosphate that is formed in the solution. Then the uranium remaining in the solution is measured by gamma spectroscopy. (M.C.G.)

15818 METHOD OF QUANTITATIVE ANALYSIS OF REDUCIBLE SUBSTANCES WITH HYDRATED ELECTRONS. Hart, Edwin J.; Fielden, Edward M. (to United States Atomic Energy Commission). U. S. Patent 3,429,667. Feb. 25, 1969.

The solution to be analyzed for a small quantity of reducible substance is adjusted to a pH of 11 to 12 and is saturated with hydrogen prior to irradiation with a low-intensity pulse of radiation capable of producing hydrated electrons in the solution. A beam of light is passed through the solution and the change in transmission of the light as the hydrated electrons decay is compared with a standard. (AEC)

Activation Procedures

Refer also to abstract 16346.

15819 APPLICATION OF SEMIPERMEABLE ION EXCHANGE MEMBRANES TO IN SITU DETERMINATION OF TRACE METAL IONS IN AQUEOUS SYSTEMS BY ELECTROCHEMICAL AND NEUTRON ACTIVATION TECHNIQUES. CRITICAL EVALUATION OF TECHNIQUES. Mark, Harry B. Jr. (Univ. of Michigan, Ann Arbor); Eisner, Uri; Rottschafer, J. Mark; Berlandi, Frances J.; Mattson, James S. Environ. Sci. Technol., 3: 165-8(Feb. 1969).

The use of ion exchange membranes in conjunction with neutron activation analysis and anodic stripping voltammetry for in situ analysis of natural water for trace metal ions systems was investigated. Studies on the parameters which govern their applicability, limitations, and sensitivity indicated that these techniques are somewhat impractical for routine trace analysis.

The relationships (or proportionality factors) relating the measured amounts of material and the concentration of these species in their original environment are complex, although they can be treated quantitatively. A long time is required to trace systems to reach equilibrium. In both analytical techniques, the ion exchange membrane was used as an in situ preconcentration matrix prior to actual analysis. (J.G.B.)

15820 INSTRUMENTAL ACTIVATION-ANALYSIS DETERMINATION OF Al, Mg, Ca, Na, Mn, AND V IN STONES. Wyttenbach, A.; Dulakas, H. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Chimia (Aarau), 22: 484-7(Dec. 16, 1968). (In German).

The determination of Al, Mg, Ca, Na, Mn, and V in rocks by instrumental neutron activation analysis is described. The method involves reactor irradiation with a pneumatic transfer system, measurement of the γ spectrum with a NaI crystal, and a least-square analysis of the spectrum by computer; each step takes at most a few minutes, and no chemical reprocessing is required. Details of the method and some typical results are given. (auth)

15821 DETERMINATION OF MERCURY IN GAS BY RADIOACTIVATION ANALYSIS. Nishimura, Kunio; Kobayashi, Gisen. Soda To Enso, 19: 377-84(Sept. 1968). (In Japanese).

The method for determining small amounts (10^{-1} to 10^{-3} mg/M^3) of Hg in H_2 gas was investigated by radioisotope tracer methods and activation analysis using ^{197}Hg as the active species. As absorbents of vaporized Hg, 4N HCl + $KClO_3$ aqueous solutions, saturated chlorine water, and concentrated HNO_3 were examined with the standard Hg-containing gas. Saturated chlorine water was the most suitable absorbent. Absorption time, Hg loss during concentration of the absorbent, and Hg absorption and elution in the irradiation capsules were studied. It was confirmed that low concentrations of Hg, whose determination was almost impossible by the prior methods, could be satisfactorily determined by the present method, the errors were within 10%. (TSS) (NSA of Japan)

15822 MEDICAL APPLICATIONS OF ACTIVATION ANALYSIS. Comar, D.; Desenne, J. J. (CEA, Orsay, France). Acta Cient. Venez., 18: 152-8(1967). (In Spanish).

The value of neutron activation analysis in medical research, particularly for the study of trace elements and processes that these support is discussed. The technique has the advantages of precision, ability to analyze very small quantities of many elements (a list of these is provided), and the convenience of nondestruction of the sample in many cases. Several examples are illustrated: determining levels of trace elements in metabolic and kinetic studies, determining normal levels, correlations in pathological states, and metabolic studies of single elements. Enrichment of stable isotopes for tracer studies in the organism after irradiation offers another possibility for metabolic study. Neutron activation analysis in vivo is described. Comparison of results from activation analysis of ^{24}Na in vivo with those from isotopic dilution is suggested to indicate the former as the simpler route for study; other studies with N and Ca offer promise for future study. (BBB)

15823 NEUTRON ACTIVATION ANALYSIS OF IMPURITIES IN QUARTZ CRYSTALS. Lobanov, E. M.; Mamadzhanov, F. I.; Babaev, A. (Physical-Technical Inst., Dushanbe, USSR). Dokl. Akad. Nauk Tadzh. SSR, 11: No. 5, 54-8(1968). (In Russian).

Miniature quartz plates were analyzed using activation techniques by irradiation in a thermal neutron flux of 10^{13} n/cm^2 sec for 15 min. The presence of Mn, Mg, Al, Ag, and In was revealed. Spectral analyses of irradiated and nonirradiated samples confirmed the data obtained by qualitative neutron activation analysis. (R.V.J.)

15824 CHEMISTRY OF RARE EARTH ELEMENTS. LIV. NONDESTRUCTIVE ACTIVATION ANALYSIS OF BROWNISH DIDYMIUM. Vobecky, M.; Petru, F. (Institut fuer Kernforschung, Prague. Technische Hochschule, Prague). Collect. Czech. Chem. Commun., 33: 3903-6(Nov. 1968). (In German).

With the help of semiconductor detectors for gamma radiation the possibility on nondestructive determination of La, Pr, Sm, and Eu in Nd is shown. The samples were irradiated with a neutron flux of ~2×10^{12} n/cm^2 sec for 30 min. (M.C.G.)

15825 ISOTOPIC DETERMINATION OF ^{48}Ca BY DEUTERON ACTIVATION. de Waal, Tielman J.; Peisach, Max; Pretorius, Rene (Southern Universities Nuclear Inst., Faure, S. Africa). Anal. Chem., 41: 416-20(Mar. 1969).

The biological use of the stable isotope ^{48}Ca for tracing required the determination of isotopic concentrations in calcium samples. The separated calcium was converted to fluoride and distilled in vacuum onto tantalum disks. After activation with 5-MeV deuterons the activities of 8.8-min ^{49}Ca gave a measure of the ^{48}Ca content and the 4-hour activities of ^{43}Sc and ^{44}Sc a measure of the natural calcium content. By using the ^{42}Ca and ^{43}Ca of natural calcium as internal standard, the isotopic concentration of ^{48}Ca was determined without the need for measuring fluxes, yields, or sample weights. Milligram quantities of calcium fluoride were analyzed with a relative standard deviation of ±2.0%. (auth)

15826 CALCULATION OF SENSITIVITIES IN PHOTON ACTIVATION ANALYSIS. Lutz, G. J. (National Bureau of Standards, Washington, D. C.). Anal. Chem., 41: 424-7(Mar. 1969).

Estimates were of specific activities to be expected from bremsstrahlung produced by an electron accelerator. The photon flux distribution from electrons striking a 0.6-cm tungsten target at different energies and included in the cone described by a 5° angle from the forward direction is calculated. Flux times cross section for photonuclear reactions of analytical utility was integrated, and disintegration rates of the reaction products for most of the elements under conditions of different electron energies and irradiation times were calculated. Relative values for the specific activities were calculated and compared with the experimental results of Oka and coworkers and found to be in satisfactory agreement. (auth)

15827 INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS USING TRIGA REACTOR HIGH-RESOLUTION GAMMA SPECTROMETER AND COMPUTER. Anders, Oswald U. (Dow Chemical Co., Midland, Mich.). Anal. Chem., 41: 428-37(Mar. 1969).

A system of elemental analysis by neutron activation is described which is capable of analyzing and assaying samples for eight or more elements simultaneously by entirely instrumental means. The gamma-ray spectra of the reactor-activated samples are collected at various times after the irradiation with a Ge(Li) detector of 13-cc sensitive volume. The computer program processes the time-dependent spectra and identifies the elemental constituents by the energy and half-life of the corresponding peaks in the spectra. The peak counting rates extrapolated to the time of the end of the activation are compared with the equivalent counting rates per milligram for the individual elements as obtained from experiments with standard samples. Typical samples were analyzed and six to eight constituents identified and assayed with relative errors of 1 to 10%. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 15878, 15919, 15929, 15936, 16543, and 16862.

15828 (APDA-184) SOLUBILITY OF SODIUM CARBONATE IN SODIUM. Carmichael, H. T.; Meacham, S. A. (Atomic Power Development Associates, Inc., Detroit, Mich.). Aug. 1968. Contract AT(11-1)-865. 24p. Dep. CFSTI.

Experiments were conducted to determine the solubility of sodium carbonate (Na_2CO_3) in liquid sodium at 150, 275, and 400°C. In the first phase of this work, undistilled commercial-grade sodium was used to qualitatively ascertain solubility, and in the second phase of experimentation, distilled sodium was used to conform with testing performed by other workers. The results of studies, using distilled sodium, indicated that the solubility of sodium carbonate in sodium is 24.4 ppM at 150°C, 37.9 ppM at 275°C, and 51.0 ppM at 400°C, with standard deviations of 4.8, 5.2, and 1.6, respectively. (auth)

15829 (BNWL-974) REACTION OF GASEOUS IMPURITIES IN A HIGH TEMPERATURE GAS-COOLED REACTOR. Giberson, R. C.; Tingey, G. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec. 16, 1968. Contract AT(45-1)-1830. 29p. Dep. CFSTI.

The Graphite Oxidation Program (GOP) computer code was updated to study the gas–graphite reactions in an HTGR. The effect of radiolytic as well as thermal reactions on the steady-state gas compositions of an operating HTGR is determined. The code is also useful in calculating the possible consequences of various reactor accidents. Water injection tests at the Dragon reactor were analyzed with the code. (auth)

15830 (DP-MS-67-110) HIGH-TEMPERATURE EVAPORATION AND THERMODYNAMIC PROPERTIES OF Cm_2O_3. Smith, P. K.; Peterson, D. E. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Mar. 8, 1968. 34p. (CONF-680308-16). Dep. CFSTI.

From 155th National Meeting of the American Chemical Society, San Francisco, Calif.

$CmO_{1.58}$ vaporizes congruently primarily to gaseous atoms. The heat and entropy of vaporization over the range 1800 to 2600°K are 665 ± 13.5 kcal/mole and 167.5 ± 6.0 eu, respectively. The Third Law and Second Law ΔH_0^0 are 678.5 ± 8.0 and 670 ± 10 kcal/mole, respectively. The melting point of Cm_2O_3 is above 2600°K. The heat of formation of Cm_2O_3(s) at 0°K is −443 ± 18 kcal/mole. The dissociation energy of CmO(g) is less than 5.8 eV. (auth)

15831 (HW-57386) A COMPILATION OF PHYSICAL AND CHEMICAL PROPERTIES OF MATERIALS AND STREAMS ENCOUNTERED IN THE CHEMICAL PROCESSING DEPARTMENT. Fleming, Ronald F. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Sept. 16, 1958. Contract [AT(45-1)-1350]. 135p. Dep. CFSTI.

Data are compiled to provide access to information commonly needed in the process engineering work of Chemical Processing Department. However, the data were made independent of specific processes, since these are subject to frequent change. An effort was made to obtain the best values of the data. Often the best value was a calculated value from parameters such as molecular models or spectroscopic data. This accumulation, however, is by no means complete. For some design requirements that may arise, reference must be made to specialized bibliographies and literature searches. Data are given on: gases, metals, chemical compounds, and systems. (P.C.H.)

15832 (LA-3967) EVALUATION OF TERNARY EUTECTIC FLUORIDE AS AN EXTINGUISHING AGENT FOR PLUTONIUM FIRES. Stearns, James G.; Miley, Franklin (Los Alamos Scientific Lab., N. Mex.). Dec. 5, 1966. Contract W-7405-eng-36. 9p. Dep. CFSTI.

Ternary eutectic fluoride and graphite fines were used on plutonium fires to determine their relative effectiveness as plutonium fire extinguishants. These tests confirmed use of graphite fines for extinguishing small fires. For larger (more than 200 g) or more scattered fires, ternary eutectic fluoride extinguishant might offer some advantage over the graphite fines because of its tendency to form an adherent, noncollapsing layer. (auth)

15833 (NYO-2008-7) THE EXCHANGE OF $H_2{}^{18}O$ WITH THE OXYGEN OF PROMOTERS ON THE SURFACE OF IRON CATALYSTS. Solbakken, V.; Solbakken, A.; Emmett, P. H. (Johns Hopkins Univ., Baltimore, Md. Dept. of Chemistry). [1959]. 15p. Dep. CFSTI

The exchange of ^{18}O between H_2O and oxide promoters on the surface of iron catalysts was studied. Al_2O_3 and K_2O were used as the promoters. (M.C.G.)

15834 (ORNL-TM-2320) EFFECTS OF GAS FLOW RATE ON THE MASS TRANSFER COEFFICIENT, MEASURED ACROSS THE LIQUID-SOLID INTERFACE, IN A PACKED-BED CATALYTIC REACTOR USING COCURRENT UPFLOW. Snider, J. W. (Oak Ridge National Lab., Tenn.). Feb. 1969. Contract W-7405-eng-26. 123p. Dep. CFSTI.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

The effect of hydrogen flow rate on the mass transfer coefficient, measured across an α-methylstyrene–palladium interface, was determined in a differential packed-bed reactor using cocurrent upflow of the gas phase and the liquid phase. The palladium catalyst was surface deposited on 0.29-cm-dia alumina spheres. The reactor, which was 1½ in. in diameter, was operated at 8 and 18 atm of hydrogen pressure. The maximum Reynolds number of the hydrogen was 75, and the Reynolds number of the liquid phase was varied from 13 to 250. The reactor temperature was varied from 23 to 40°C, and the feed composition entering the reactor was varied from 10 to 70 mole percent α-methylstyrene. Three catalyst beds, either 12 or 18 in. in depth, were studied, and it was found that the kinetic rate equation had to be modified to account for differences in the catalytic activities of the beds. Results of this study showed that both the rate of hydrogen transfer to the surface of the catalyst and the kinetic rate at the surface of the catalyst affect the mass transfer coefficient. Whenever the concept of uniformly accessible surface was used, the experimentally determined j factor for mass transfer at low hydrogen flow rates agreed with that reported for single-phase flow in packed beds. When the Reynolds number of the liquid phase was held constant, increasing the Reynolds number of the hydrogen from 10 to about 35 increased the j factor for mass transfer by 300 percent. At higher values of the Reynolds number of the hydrogen, the liquid phase became fluidized. The j factor for mass transfer was also found to increase by 50 percent whenever the liquid phase was pumped in a pulsing manner. (auth)

15835 (ORNL-TM-2476) INTERACTIONS IN ALKALI METAL SOLUTIONS CONTAINING OXYGEN. I. THE NIOBIUM–OXYGEN–POTASSIUM SYSTEM. Klueh, R. L. (Oak Ridge National Lab., Tenn.). Feb. 1969. Contract W-7405-eng-26. 28p. (CONF-680313-3). Dep. CFSTI.

From 24th Annual National Association of Corrosion Engineers Conference, Cleveland, Ohio.

As an alternative to the ternary oxide hypothesis, which assumes that dissolution of refractory metals increase drastically when alkali metals contain oxygen, studies were made on the possibility that at equilibrium only two condensed phases are present and that the oxygen affects the solubility of the refractory metal by decreasing the activity coefficient of the refractory metal in the liquid. The interplay between solute species in refractory metal–oxygen–alkali metal systems can be characterized in terms of interaction parameters as developed by Wagner. This approach was evaluated using data from the niobium–oxygen–potassium system at 600°C. The observed solubility of niobium as a function of the oxygen content in potassium was consistent with that expected on the basis of calculated interaction parameters. Analysis of the observed behavior in terms of the phase rule also indicated that only two condensed phases exist at equilibrium. (P.C.H.)

15836 ON THE INFLUENCE OF ELECTRON CONFIGURATION OF MO_2^+ AND MO_2^{2+} IONS ON THE POTENTIALS OF M(IV)–M(V) AND M(IV)–M(VI) PAIRS IN A SERIES OF ACTINIDES. Rykov, A. G. Radiokhimiya, 10: 725-7(1968). (In Russian).

The influence of electron configuration valence of MO_2^+ and MO_2^{2+} on the potentials of M(IV)–M(V) and M(IV)–M(VI) pairs in U, Np, Pu, and Am was studied. The tendency of ions M^{4+} or MO_2^+ to disproportionating reaction determined by the magnitudes of M(IV)–M(V) and M(III)–M(IV), or M(IV)–M(V) and M(V)–M(VI) was analyzed and the variations of potentials of various pairs in a series of actinides were correlated. It was observed that potentials in oxygen-containing ions having an even electron configuration ($UO_2^{2+}-5f^0$, $NpO_2^+-5f^2$, $PuO_2^{2+}-5f^2$, $AmO_2^+-5f^4$) are lower than anticipated for monotonous potential changes with the increasing atomic number of the element. The potentials of the pairs with oxygen ions with odd electron configuration ($UO_2^+-f^1$, $NpO_2^{2+}-5f^1$, $PuO_2^+-5f^3$, and $AmO_2^{2+}-5f^3$) are abnormally high. Equations obtained indicate that sharp periodicity in variations of equilibrium constants in the disproportionating reaction of actinide ions MO_2^+ is due to the variations of even parity in their electron configuration. (R.V.J.)

15837 HYDROGEN-BONDED SOLVENT SYSTEMS. Proceedings of a Symposium on Equilibria and Reaction Kinetics in Hydrogen-Bonded Solvent Systems, University of Newcastle upon Tyne, Eng., 10–12 January 1968. Covington, A. K.; Jones, P. (eds.). London, Taylor and Francis Ltd., 1968. 365p. £6.0.0.; $14.70. (CONF-680117).

Twenty-four papers were presented which considered recent work on the structure of hydrogen-bonded solvents and the role of the solvent medium in solute–solute and solute–solvent equilibria and rate processes. Separate abstracts were prepared for five papers. (D.H.M.)

For abstracts of individual papers see: 15838–15841 and 15878.

15838 STRUCTURE OF WATER. Walrafen, G. E. (Bell Telephone Labs., Inc., Murray Hill, N. J.). pp 9-29 of Hydrogen-Bonded Solvent Systems. Covington, A. K. (ed.). London, Taylor and Francis Ltd., 1968.

From Symposium on Equilibria and Reaction Kinetics in Hydrogen-Bonded Solvent Systems, Newcastle upon Tyne, Eng. See CONF-680117.

A theory of water structure arising primarily from recent Raman intensity measurements but consistent with a wide range of physical observations is presented. New experimental techniques and instrumentation which offers promise in future Raman investigations of water and aqueous solutions are described, including argon-ion-laser-source, high-pressure laser-Raman cell, and special-purpose analogue computer. Intermolecular vibrations of water (including effects of temperature and pressure) and intramolecular valence vibrations (including spectral detail in the uncoupled OD stretching region and temperature dependences of component intensities from HDO), are discussed. Current and future investigations of the structure of pure water and aqueous solutions of electrolytes and nonelectrolytes are described. (D.H.M.)

15839 MECHANISMS FOR DECARBOXYLATION OF AROMATIC ACIDS IN ACIDIC AQUEOUS SOLUTIONS. Long, F. A. (Cornell Univ., Ithaca, N. Y.). pp 285-94 of Hydrogen-Bonded Solvent Systems. Covington, A. K. (ed.). London, Taylor and Francis Ltd., 1968.

From Symposium on Equilibria and Reaction Kinetics in Hydrogen-Bonded Solvent Systems, Newcastle upon Tyne, Eng. See CONF-680117.

Aromatic carboxylic acids in solution show several types of decarboxylation behavior, depending on the character of the aromatic system and on the substituents present. Thus trinitrobenzoic acid shows a rate of decomposition which increases with increasing pH and the evidence suggests that it is the carboxylate anion which decomposes. For some other classes of aromatic carboxylic acids the decomposing species is ArCOOH itself, and for still others acid catalysis is observed, suggesting that the decomposing species is $ArCOOH_2^+$. From studies by several groups with aminosubstituted aromatic carboxylic acids, there is evidence that a species of the structure H^+ / $Ar-COO^-$ enters as an intermediate. Recent studies on the decarboxylation of azulene-1-carboxylic acid by Longridge and Long (1968) confirm this last proposal for a simple unsubstituted acid. The available equilibrium and kinetic data for decarboxylation reactions are discussed in terms of the possible intermediates and transition states. (auth)

15840 KINETIC STUDIES IN THE H_2O–D_2O SOLVENT SYSTEM. Gold, V. (King's Coll., London). pp 295-300 of Hydrogen-Bonded Solvent Systems. Covington, A. K. (ed.). London, Taylor and Francis Ltd., 1968.

From Symposium on Equilibria and Reaction Kinetics in Hydrogen-Bonded Solvent Systems, Newcastle upon Tyne, Eng. See CONF-680117.

Hydrogen-ion catalyzed reactions show characteristic kinetic isotope effects in H_2O–D_2O media. These effects were studied both for reactions involving pre-equilibrium protonation (deuteronation) of the substrate and for reactions in which the protonation (deuteronation) is associated with the rate-limiting step. The experimental phenomena are reasonably well described by a theoretical model in which the isotope effect on the reaction is considered to be confined to the H_3O unit in the hydrogen ion and in the transition state of the reaction. Various assumptions implicit in this treatment (especially the applicability of the rule of the geometric mean and the neglect of transfer effects) have recently been probed in different ways. These developments and their effect on the present status of the theory are discussed. (auth)

15841 THE ROLE OF HYDROGEN BONDING IN SOME PEROXIDE OXIDATIONS OF ORGANIC SULPHUR COMPOUNDS. Curci, Ruggero (Univ., Bari, Italy); DiPrete, Ronald; Edwards, John O.; Modena, Giorgio. pp 303-21 of Hydrogen-Bonded Solvent Systems. Covington, A. K. (ed.). London, Taylor and Francis Ltd., 1968.

From Symposium on Equilibria and Reaction Kinetics in Hydrogen-Bonded Solvent Systems, Newcastle upon Tyne, Eng. See CONF-680117.

During the past fifteen years, a number of detailed studies on the oxidations of organic sulfides and of organic sulfoxides by peroxides ROOH have been carried out. Although the stoichiometry is uncomplicated, being in appearance a simple oxygen atom transfer, the rates and the rate laws depend significantly on the solvent. In the oxidation of 1-oxa-4-thiacyclohexane by hydrogen peroxide in protonic solvents, the observed rate laws are first order in each reactant and the order of the rate constants is AcOH > H_2O > D_2O > CH_3OH > iso-PrOH > tert-BuOH. In purified non-protonic solvents, the reaction is much slower and the rate law is third order, being first order in sulfide and second order in peroxide. Addition of small amounts of protonic solvents to the dioxan markedly increases the rates, in proportion to the added amount. The rate constants are more a function of the "acidity" than of the "polarity" of the solvent. By way of comparison, the rate of oxidation of sulfoxides to sulfones decreases in going from non-protonic to protonic solvents. Experimental data are presented, and possible transition states and ground states involving hydrogen bonds to solvents are discussed. (auth)

15842 REACTIONS OF UO_2 AND Fe_2O_3 IN DILUTE SOLUTIONS OF H_2SO_4 AT 200°C. Vlasov, A. D.; Galkin, N. P. Zh. Neorg. Khim., 14: 36-9(Jan. 1969). (In Russian).

The oxidation of uranium dioxide by trivalent iron in weak solutions of sulfuric acid at 200°C was studied. The type of reaction that proceeds in the system was established. The reaction constant and change of free energy were calculated. It is shown that di- and trisulfate uranyl complexes are formed in the system in insignificant quantities. (tr-auth)

15843 RECIPROCAL SUBSTITUTION OF FLUORIDE AND OXALATE LIGANDS IN URANYL COMPOUNDS. Shchelokov, R. N.; Belomestnykh, V. I. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim., 14: 238-42(Jan. 1969). (In Russian).

It is shown that substitution reactions of uranyl compounds, proceeding with participation of fluoride and oxalate ligands, are reversible. The structure of mixed fluoride and oxalate complexes is discussed and an assumption was made concerning pentacoordinated uranyl ions in these compounds. (tr-auth)

15844 ABSORPTION SPECTRA OF ACTINIDES AND THE ELECTRONIC NATURE OF CHEMICAL BONDS IN THE URANYL GROUP. Umreiko, D. S.; Sevchenko, A. N.; Novitskin, G. G. (Belorussian State Univ., Minsk). Dokl. Akad. Nauk BSSR, 12: 884-7(Oct. 1968). (In Russian).

Studies were made on the correlation of the absorption spectra (region of the coefficient of the molar extinction and the nature of the structure) of actinide compounds (from actinium to americium), and it was concluded that 5f electrons of hexavalent U participate in the formation of chemical bonds and optical excitation in the uranyl group, UO_2^{2+}. It was assumed that an increase in the energy of 5f electrons was induced by reactions (possibly by hybridization) with 6d electrons. (tr-auth)

15845 VIBRONIC ANALYSIS OF THE ABSORPTION SPECTRUM OF THE URANYL ION. De Jaegere, S.; Goerller-Walrand, C. (Univ., Louvain, Belgium). Spectrochim. Acta, Part A, 25: 559-68(Mar. 1969).

A calculation of the potential energy curves for the first three excited states of the uranyl ion is proposed. Because of the lack of clearly defined progressions in the absorption spectrum, experimental values of the dissociation energy are introduced into the calculations. These values are obtained from the positions of the distinct continua, observed by Pringsheim in the ultraviolet part of the absorption spectrum. This enables calculation of theoretical progressions, which were found to be in good agreement with the poorly defined experimental progressions. The vibronic analysis proposed allows also for a quite reasonable interpretation of the intensity distribution in the absorption spectrum of the uranyl ion. (auth) (UK)

15846 HALIDES AND OXIDE HALIDES OF TECHNETIUM. I. TECHNETIUM(V) OXIDE HALIDES AND THE REACTION OF THIONYL CHLORIDE WITH AMMONIUM PERTECHNETATE. Colton, R.; Tomkins, I. B. (Univ. of Melbourne, Parkville, Australia). Aust. J. Chem., 21: 1981-5(Aug. 1968).

Two products are obtained when TcO_2 is chlorinated at temperatures exceeding 200°C. One is a blue, extremely volatile compound, which sublimes with some decomposition even in Cl_2. The compound is stable only under partial pressures of 20 to 30 cm Cl_2 and rapidly decomposes to $TcOCl_3$ when the Cl_2 atmosphere is replaced with N_2. The compound is believed to be $TcOCl_4$. The second product, which is brown and sublimes unchanged at temperatures exceeding 500°C, was shown to be $TcOCl_3$. Bromine vapor carried in a stream of N_2, reacts with TcO_2 at 300 to 350°C to give $TcOBr_3$. Bromine vapor reacts with NH_4TcO_4 at 350 to 400°C to give $TcOBr_3$. Pertechnyl bromide, TcO_3Br, was not isolated, but the corresponding chloride is thermally unstable, and decomposes to a red involatile product believed to be the trioxide. The reaction of Br_2 with the thermally stable $KTcO_4$ was found to give $TcOBr_3$ as the main product, although a red product, believed to be the potassium salt of an oxobromo technetium anion, was observed at 300 to 400°C. Ammonium pertechnetate reacted slowly with thionyl chloride at room temperature. After 2 days an orange precipitate formed, which was known to be the ammonium dioxotetrachlorotechnetate(VI)–sulfuryl chloride adduct. (BBB)

15847 EFFECT OF DEUTERATION ON THE SPONTANEOUS POLARIZATION OF KH_2PO_4 CRYSTALS. Azoulay, J. (Tel Aviv Univ., Israel); Grinberg, Y.; Pelah, I.; Wiener, E. J. Phys. Chem. Solids, 29: 843-9(May 1968).

An accurate method of measuring spontaneous polarization, which overcomes the problem of the long relaxation time, was developed. The method is based on the possibility of releasing the spontaneous charge by heating the crystal through its Curie point. The values obtained are: $P_S(KH_2PO_4) = 5.12\ \mu\ C/cm^2$ and $P_S(KD_2PO_4) = 6.15\ \mu\ C/cm^2$. The difference is interpreted as resulting from the persistence of tunneling of the hydrogens in an asymmetric double minimum potential well. The asymmetry parameter was calculated to be $B = 540\ cm^{-1}$. A polarization tail above the Curie temperature was observed, and a picture of regenerative processes between imperfections and the dielectric behavior of the medium is suggested. In crystals this effect may also cause a "smearing" of phase transitions. (auth) (UK)

15848 CHEMICAL REACTIONS IN IONIC MATRICES. Hisatsune, I. C. (Pennsylvania State Univ., University Park). Nippon Kagaku Zasshi, 89: 1143-56(Dec. 1968). (In Japanese).

Pressed alkali halide disks, which are used commonly to obtain

the infrared spectra of solid compounds, were found to be convenient matrices in which solid state chemical reactions of organic and inorganic ions can be examined. These reactions can be induced thermally or by irradiation, and their kinetics can be followed spectroscopically. In thermal decomposition reactions involving weight changes, the kinetic results obtained with these disks by infrared spectroscopy agree with those from the thermogravimetric analysis. In gamma irradiation studies, ion free radicals are trapped readily in these disks even at room temperature, and the decay of these radicals can be followed by electron spin resonance spectroscopy. When the concentrations of these radicals are sufficiently great, their chemistry as well as their absorption spectra can be investigated. Experiments carried out to date indicate that the use of pressed disks can extend the field of solid state chemical kinetics and matrix isolation studies. (auth)

15849 BEHAVIOR OF NITROUS ACID IN TRIBUTYL PHOSPHATE EXTRACTIONS. Gourisse, D.; Gautier, A. (CEN, Fontenay-aux-Roses, France). J. Inorg. Nucl. Chem., 31: 839-50(Mar. 1969). (In French).

The partition coefficients of nitrous acid in the system TBP 30% – Dodecane – $UO_2(NO_3)_2$ – HNO_3 – H_2O were measured. An original experimental method avoiding nitrous acid decomposition was used. The variations of the partition coefficients versus uranium and acid concentrations are explained by simple calculations. The behavior of nitrous acid in multi-stage counter-current extraction was also studied. The decomposition of HNO_2 did not affect the values of the partition coefficient in each stage. (auth) (UK)

15850 THE ISOTOPE EFFECT IN THE Ti(III) TO Ti(IV) OXIDATION REACTION BY ORDINARY AND DEUTERATED HYDROXYLAMINE. Calusaru, A. (Institute of Atomic Physics, Bucharest). Isotopenpraxis, 4: 401-4(Oct. 1968). (In French).

In the reduction of Ti(IV) to Ti(III) at a mercury dropping electrode the corresponding current is increasing in the presence of hydroxylamin according to the reaction $Ti^{3+} + NX_2OX + X^+ \xrightarrow{k_X} Ti^{4+} + NX_2\cdot + X_2O$, which is superimposed on to the reaction at the electrode. X can be either H or D. By means of the kinetic current caused by this reaction it is possible to determine the rate constants k_H and k_D by the method of polarography. The quotient of these constants, i.e., the isotope effect of the oxidation reaction Ti(III) – Ti(IV) by hydroxylamin, was found to be about 3. (auth)

15851 A NEW CELL FOR ELECTROCHEMICAL STUDIES AT ELEVATED TEMPERATURES: DESIGN AND PROPERTIES OF A CELL INVOLVING A COMBINATION OF THORIUM OXIDE–YTTRIUM OXIDE AND ZIRCONIUM OXIDE–CALCIUM OXIDE ELECTROLYTES. Tretyakov, Yu. D. (Moscow State Univ.); Muan, Arnulf. J. Electrochem. Soc., 116: 331-4(Mar. 1969).

A "double-cell" involving a combination of ZrO_2-CaO and ThO_2-Y_2O_3 solid electrolytes was developed for emf measurements at elevated temperatures. The cell utilizes the desirable properties of the ZrO_2-CaO electrolyte at relatively high oxygen pressures and the desirable properties of the ThO_2-Y_2O_3 electrolyte at very low oxygen pressures to make it operative over a considerably wider range of oxygen pressures than has been possible with previously described cells. (auth)

15852 STABILITY CONSTANT OF Pa(V)–EDTA COMPLEX. Shiokawa, T.; Kikuchi, M.; Omori, T. (Tohoku Univ., Sendai). Inorg. Nucl. Chem. Lett., 5: 105-9(Feb. 1969).

The stability constant was determined by a solvent extraction method. Carrier-free ^{233}Pa was used as tracer, with TTA (thenoyltrifluoroacetone) as extracting agent, the distribution coefficient for TTA being determined by measuring the gamma activity in both phases (HCl and TTA) with a single channel gamma spectrometer. The dependence of the distribution coefficient on pH is shown graphically both for TTA and for TTA/EDTA. The distribution at pH 0 to 2 for TTA could be expressed by $Pa(OH)_2^{3+} + 4\,HT \rightleftharpoons Pa(OH)_2\,T_3\cdot HT + 3H^+$, where HT is the TTA molecule. In the presence of EDTA decrease of the distribution coefficient was observed, indicating that Pa(V) forms a stable complex even in lower pH regions. The charge of the complex was found to be negative by paper electrophoresis technique. The formation constant of the complex could be expressed by $K = [Pa(OH)_2\gamma^-]/[Pa(OH)_2^{3+}]\,[\gamma^{4-}]$, where γ^{4-} indicates the tetravalent EDTA anion, and the distribution coefficient was given by $D = [Pa(OH)_2T_3\cdot HT]_o/[Pa(OH)_2^{3+}]_\alpha + [Pa(OH)_2\gamma^-]_\alpha$. The logarithmic stability constant was found to be 22.1 ± 0.1 as an average value for different pH values. (UK)

15853 URANIUM(III) AND URANIUM(IV) FORMATES AND THEIR MAGNETIC PROPERTIES. Jezowska-Trzebiatowska, B.; Drozdzynski, J. (Univ. of Wroclaw). J. Inorg. Nucl. Chem., 31: 727-31(Mar. 1969).

Two new uranium compounds were prepared, $U(HCOO)_3$ and $U(HCOO)_4$. The magnetic susceptibilities of $U(HCOO)_3$, $Nd(HCOO)_3$ [isomorphous with $U(HCOO)_3$] and $U(HCOO)_4$ were measured over the temperature range 82 to 300°K. The magnetic behavior of $U(HCOO)_3$ is consistent with that expected for an ion with three unpaired f electrons. (auth)

15854 FRACTIONATION OF HYDROGEN AND DEUTERIUM ISOTOPES IN SOLUTIONS OF SODIUM METHOXIDE. O'Ferrall, R. A. More (Oxford Univ.). Chem. Commun., No. 3, 114-15 (Feb. 5, 1969).

Measurements were made on the fractionation of H and D isotopes in solutions of sodium methoxide at 25 ± 2° with an NMR spectrometer with dioxane (<1%) as an internal standard. The value for the fractionation factor, ϕ, was determined to be 0.76. The results for sodium methoxide were compared with similar measurements of the fractionation factors for the hydronium ion (0.69) and for the hydroxide ion (ca 0.8) in aqueous solution. It was concluded that the presumption that fractionation with the solvent is effectively confined to a single set of equivalent hydrogens associated with the methoxide ion is not without foundation. It is also believed to be improbable that important fractionation effects for the methoxide ion could persist beyond its primary solvation shell. (P.C.H.)

15855 PRECIPITATION OF URANYL ION IN FUSED POTASSIUM THIOCYANATE. Yanagi, Tadashi (Osaka Univ.). Bunseki Kagaku, 18: 195-8(Feb. 1969). (In Japanese).

The variations of concentration with time of several metal ions dissolved in fused potassium thiocyanate at 190°C were investigated. It was found that the concentration of cadmium, lead, or neodymium ion did not vary with time in this fused solvent for more than ten hours. However, uranyl ion separated after a few hours as a black precipitate resulting from the chemical reaction with the fused salt solvent. The concentration of uranyl ion therefore decreased with time, while that of the other metal ions remained constant. The chemical analyses of the black precipitate showed that it contained 76.8% of uranium and 10.6% of sulfur, the values being in good agreement with the composition of uranyl sulfide. The content of the metal ions in the black precipitate obtained by heating the molten salt solution for a long time at 190°C was Cd 1.86%, Pb 4.36%, Ce 6.97%, and Nd 8.47%. It is supposed that these were caused by their coprecipitation with uranyl ion. (auth)

15856 AROMATIC PROTONATION. III. KINETIC HYDROGEN ISOTOPE EFFECTS ON ACID-CATALYZED AROMATIC HYDROGEN EXCHANGE IN 1,3,5-TRIMETHOXYBENZENE. Kresge, A. J.; Chiang, Y. (Illinois Inst. of Tech., Chicago. Massachusetts Inst. of Tech., Cambridge). Contract AT(11-1)-1025. J. Amer. Chem. Soc., 89: 4411-17(Aug. 16, 1967). (COO-1025-42).

Rates of aromatic hydrogen exchange in 1,3,5-trimethoxybenzene catalyzed by dilute aqueous $HClO_4$ were measured for 4 systems, which used the 3 isotopes of hydrogen as tracers in different pairwise combinations. Kinetic analysis of the results in terms of the known two-step mechanism of this reaction shows that secondary isotope effects must be taken into account and that the Swain relation between deuterium and tritium isotope effects is valid. The product of primary and secondary isotope effects on hydrogen ion transfer from the hydronium ion to isotopically identical substrates is 3.59 ± 0.11 (k_H/k_D), and the secondary isotope effect produced by hybridization changes in the nonreacting bond of the aromatic substrate in this step of the reaction is 0.90 ± 0.03 (k_H/k_D). The quotient of primary and secondary isotope effects on hydrogen ion loss from the phenonium ion intermediate is 8.1 ± 0.03 (k_H/k_D). The secondary isotope effect on this step of the reaction is also produced by hybridization changes in the nonreacting bond of the aromatic substrate, and there is reason to expect it to be the reciprocal of the corresponding isotope effect on the other step of the reaction. This gives the primary isotope effect on hydrogen ion loss from the phenonium ion intermediate the value 9.0 ± 0.4 (k_H/k_D). (auth)

15857 AROMATIC PROTONATION. IV. ACTIVATION PARAMETERS FOR ACID-CATALYZED AROMATIC HYDROGEN EXCHANGE IN 1,3-DIMETHOXYBENZENE AND 1,3,5-TRIMETHOXYBENZENE. Kresge, A. J.; Chiang, Y.; Sato, Y. (Illinois Inst. of Tech., Chicago). Contract AT(11-1)-1025. J. Amer. Chem. Soc., 89: 4418-24(Aug. 16, 1967). (COO-1025-43).

The loss of tritium from 1,3-dimethoxybenzene-4-t was found to be catalyzed by formic acid in dilute aqueous buffer solutions. This indicates that the two-step, protonation–deprotonation reaction sequence established as the mechanism for aromatic hydrogen exchange in more reactive substrates applies to this substance as well; the range of substrate reactivity over which this mechanism is known to be operative now extends to 10^7. Rates of loss of tritium from 1,3-dimethoxybenzene-4-t catalyzed by

formic and perchloric acids and from 1,3,5-trimethoxybenzene-2-t catalyzed by biphosphate ion and perchloric acid were each measured at several temperatures. These data permit the calculation of enthalpies and entropies of activation for proton transfer from these acids to the respective aromatic substrates. These activation parameters describe a pattern which can be understood in terms of solvation changes, and this, in turn, suggests that these proton transfers are, at least in part, adiabatic processes. (auth)

15858 ISOTOPIC HYDROGEN EXCHANGE IN THE ALKYLBENZENES USING HOMOGENEOUS PLATINUM CATALYSTS. Hodges, R. J.; Garnett, J. L. (Univ. of New South Wales, Sydney). J. Catal., 13: 83-98(Jan. 1969).

Exchange in the alkylbenzenes was studied in acetic acid solutions using sodium and potassium chloroplatinites as catalysts. Steric hindrance to exchange was observed in both aromatic and alkyl positions ortho to an alkyl group. Exchange proceeded at comparable rates in both aromatic and alkyl positions. The high predominance of multiple exchange reactions indicates the presence of intermediate complex species, presumably formed through π-bonding. Possible mechanisms for the reaction are discussed. Evidence indicates that exchange in alkyl positions is preceded by a reversible dealkylation of the side chain. Exchange rates in representative alkylbenzenes by acid-catalyzed, homogeneous platinum-catalyzed, and heterogeneous metal-catalyzed exchange are compared. (auth)

15859 STUDIES OF THE ALKALINE EARTH COMPLEXES IN VARIOUS SOLUTIONS. IV. SOLVENT EXTRACTION STUDY OF RADIUM(II) COMPLEXES WITH SOME AMINOCARBOXYLIC ACIDS IN PERCHLORATE MEDIA. Sekine, Tatsuya; Kawashima, Yoshimitsu; Unnai, Takaaki; Sakairi, Mitsuo (Science Univ., Tokyo). Bull. Chem. Soc. Jap., 41: 3013-15(Dec. 1968).

The complex formation of Ra(II) with six very common aminocarboxylic acids was studied by a liquid-liquid distribution method. The aminocarboxylic acids used were EDTA, DTPA, EGTA, CDTA, HEDTA, and NTA. Ra(II) was extracted with a mixture of thenoyltrifluoroacetone (TTA) and TBP in CCl_4. Stability constants were determined by a graphic method from the distribution data. (P.C.H.)

15860 FORCE CONSTANTS AND MEAN-SQUARE AMPLITUDES OF VIBRATION OF HEXACHLOROURANATE ION (UCl_6^{2-}). Pandey, A. N.; Singh, H. S.; Sanyal, Nitish K. (Univ. of Gorakhpur, India). Curr. Sci. (India), 38: 108-9(Mar. 5, 1969).

The force constants employing modified Urey Bradley Force Field (MUBFF) and generalized quadratic potential field (GQPF) are reported for UCl_6^{2-}. It was found that the results are better reproduced with the general quadratic potential field than MUBFF. Calculations on generalized mean square amplitude quantities and the mean amplitudes of vibration showed that the mean amplitudes of vibrations for bonded as well as the nonbonded distances increase with temperature. (P.C.H.)

15861 Li_5NpO_6, THE FIRST CRYSTALLINE COMPOUND WITH SEPTIVALENT NEPTUNIUM, AND THE EXISTENCE OF SEPTIVALENT PLUTONIUM AND AMERICIUM. Keller, C.; Seiffert, H. (Univ., Karlsruhe, Ger. Kernforschungszentrum Karlsruhe, Ger.). Inorg. Nucl. Chem. Lett., 5: 51-7(Jan. 1969). (In German).

The preparation and analysis of pure Li_5NpO_6 are described, together with some of its properties. Comparison is made with Re and Tc analogues. Corresponding reactions indicated the existence of Pu(VII) but not of Am(VII). (UK)

15862 MOLECULAR MOTION IN MOLECULAR SIEVES BY NEUTRON SCATTERING SPECTROSCOPY. Egelstaff, P. A. (Atomic Energy Research Establishment, Harwell, Eng.); Downes, J. Stretton; White, J. W. pp 306-18 of Molecular Sieves. London, Society of Chemical Industry, 1968.

From Conference on Molecular Sieves, London, Eng. See CONF-670455-1.

Neutron scattering may be employed as a new spectroscopic tool for measuring molecular vibrational, rotational, and diffusive motions on the 10^{-11} to 10^{-13} second time scale. Molecules trapped in the cages of molecular sieves move from one side to another and have vibrational periods, when attached to the walls, in this time range. The technique provides new information about these motions, and some of the range of its usefulness is reviewed. Exploratory studies on molecular sieves containing water, heavy water, methyl alcohol, methyl cyanide, and ammonia were made. The vibrational spectra of the trapped molecules between 0.6 MeV (5 cm^{-1}) and 70 MeV (600 cm^{-1}) were compared with the spectra of the free molecules. The results indicate that the molecules are located at the equivalent of lattice sites, that their vibrational spectrum is similar to the lattice, that the thermal cloud (for the protons at least) is anisotropic, and that the molecule remains at one site for $\sim 2 \times 10^{-11}$ sec only. It was concluded that the neutron scattering spectroscopic technique has considerable potential for studying trapped molecular motions. (auth) (UK)

15863 MOLECULAR SIEVES, CONFERENCE HELD AT THE SCHOOL OF PHARMACY (UNIVERSITY OF LONDON), 4-6 APRIL, 1967. London, Society of Chemical Industry, 1968. 334p. (CONF-670455).

Thirty-three papers are presented under the following headings: Mineralogy and Structure, Synthesis, Catalysis, Zeolite, Modification and Regeneration, Applications, Sorption and Diffusion Phenomena, and General Properties. Separate abstracts were prepared for three papers dealing with neutron scattering spectroscopy of molecular sieves, fast-neutron damage, and ESR studies of radioinduced magnetic centers. (D.L.C.)

For abstracts of individual papers see: 15862, 15892, and 16886.

15864 PROCESS FOR MAKING A URANIUM TRIOXIDE AQUASOL. (to W. R. Grace and Co.). British Patent 1,142,470. Feb. 5, 1969. Priority date Mar. 15, 1967, United States.

Uranium trioxide sols are prepared by decomposing ammonium diuranate to anhydrous UO_3 by heating at a temperature of 200 to 450°C, mixing the anhydrous UO_3 with sufficient H_2O to provide a concentration of up to 300 wt % UO_3 in the mixture, and hydrating the anhydrous UO_3 to form an aquasol of colloidal UO_3 hydrate particles. Physical agitation of the mixture promotes hydration. (B.L.M.)

15865 CHEMISTRY OF THE ACTINIDES. Asprey, L. B.; Penneman, R. A. (Los Alamos Scientific Lab., N. Mex.). Chem. Eng. News, 45: 74-92(July 31, 1967). (LA-DC-8368).

A review is presented on the discovery, chemistry, production, and uses of the actinides. Special attention is given to the oxidation states that are common to the actinides. The many exceptions that are noted suggest that each element has unique chemical properties. Thus, each element is also discussed separately. (P.C.H.)

15866 GALLIC ACID COMPLEXES. II. SPECTROPHOTOMETRIC STUDY OF GALLIC ACID-URANYL COMPLEXES IN AQUEOUS SOLUTIONS. Chou, Mu-i; Ts'ui, Chen-chi. Acta Sci. Natur. Univ. Jilinensis, No. 2, 115-21(1965). (In Chinese).

Measurements were made of the absorption spectra of the gallic acid complexes with uranyl in aqueous solutions with pH values ranging from 2 to 7 in the region of 3000 to 5000 A; the shape of absorption curves was characterized by a noticeable inflection in the region of 3200 to 3500 A; the complex was stable at pH values of 4.5 to 5.5 and had the ratio of 1:1. The values of its apparent stability constant and extinction factor were 1.45×10^5 and 1.24×10^4, respectively. (JPRS)

15867 COMPLEXES OF URANIUM(VI) AND THORIUM(IV) WITH 2-HYDROXY-5-METHYLACETOPHENONE. Gupta, B. D.; Malik, W. U. (Univ. of Roorkee, India). J. Less-Common Metals, 17: 271-5(Mar. 1969).

The reactions of 2'-hydroxy-5'-methylacetophenone with uranium(VI) and thorium(IV) were studied by both colorimetric and conductometric methods. The reactions are instantaneous and take place in acidic media. Uranyl ions develop an orange color and thorium ions a yellow color with this reagent. The solutions are highly stable and their color intensity remains unchanged, even on keeping for a week or so. Temperature variations up to 80°C have no effect on their color intensity. It is demonstrated that only one complex is formed in each reaction. The composition of the complexes determined by both Job's method of continued variation and the slope ratio method was found to be a 2:1 complex with uranium and a 1:1 complex with thorium. The values of the stability constants of the uranium and thorium complexes were calculated to be 1.4×10^7 and 2.66×10^2 and $-\Delta G°$ to be 9.91 and 3.35 kcal/mol at 30°C, respectively. (auth)

15868 STUDIES ON MOLYBDENUM(VI) 0-HYDROXYACETOPHENONEOXIME. Gupta, B. D.; Malik, W. U. (Univ. of Roorkee, India). J. Less-Common Metals, 17: 277-82(Mar. 1969).

Ortho-hydroxyacetophenoneoxime reacts instantaneously with molybdenum in acidic media to give a highly-stable, bright yellow, soluble complex. Vosburgh and Cooper's method showed the existence of only one complex in the yellow solution with maximum absorption at 345 mμ. The complex was found to be stable at pH 2.5 to 5.5. Both Job's method of continued variation and the slope ratio method revealed its composition as 1:2 (molybdenum : reagent). The stability constant of the complex was determined by Anderson's method and found to be 9.3×10^8 and $-\Delta G° = 12.39$ kcal/mol at 30°C. The results of chemical analysis of the isolated complex for its nitrogen molybdenum contents correspond to its

molecular formula of $(C_8H_8O_2N)_2 \cdot MoO_2$. The infrared spectral studies provide evidence that the phenolic hydrogen is replaced by MoO_2^{++} which, in turn, is coordinated to the nitrogen of the oxime (–C = NOH) group to form a chelate compound. (auth)

15869 DISTRIBUTION EQUILIBRIA OF $PrCl_3$–$NdCl_3$–$SmCl_3$–HCl SYSTEM WITH 1.0 M DI(2-ETHYLHEXYL)PHOSPHORIC ACID IN n-HEPTANE. Goto, Totaro (Government Chemical Industrial Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 6: 63-8(Feb. 1969).

The presence of one lanthanide has been found to inhibit or promote the extraction of the other lanthanide present in the two salt extraction systems of $PrCl_3$–$SmCl_3$–HCl and $NdCl_3$–$SmCl_3$–HCl, with 1.0 M di(2-ethylhexyl) phosphoric acid in n-heptane. This mutual interference effect has been quantitatively expressed by means of a new parameter. The three salt system of $PrCl_3$–$NdCl_3$–$SmCl_3$–HCl can be reduced virtually to a "two salt" system of (Pr + Nd) Cl_3–$SmCl_3$–HCl and a rough estimation of distribution equilibrium of this system is possible with the use of the above-mentioned parameters. (auth)

15870 KINETICS OF COMPLEX HETEROGENEOUS CATALYTIC REACTIONS. II. KINETICS OF KETONISATION OF ALIPHATIC ACIDS AND THEIR MIXTURES ON THORIA. Rybacek, L.; Setinek, K. (Inst. of Chemical Process Fundamentals, Prague). Collect. Czech. Chem. Commun., 33: 3528-40(Nov. 1968).

The kinetics of parallel heterogeneous reactions were studied using the catalytic ketonization of acetic and propionic acids as the model reaction. The forms of the kinetic equations and the values of the constants appearing in them were determined both for the ketonization of the individual acids and for the parallel reaction of the two substances. From the effect of the addition of the products to the respective reaction mixtures the values of the adsorption coefficients of the products were determined. This enabled, for a wide range of degrees of conversion, the experimentally determined courses of the reactions to be compared with those calculated. It was found that the kinetic equations of the Langmuir–Hinshelwood type represent well both the individual and parallel reactions, and, when the effect of the products is included, the description is also good in the range of higher conversions. From a comparison of the constants of the kinetic equations obtained it was concluded that the method applied yields true rate constants, and that, regardless of the number of components present in the system, the values of the adsorption coefficients of reactants and products are constant. (auth)

15871 ANNUAL REVIEW OF PHYSICAL CHEMISTRY. VOLUME 19. Eyring, H.; Christensen, C. J.; Johnston, H. S. (eds.). Palo Alto, Calif., Annual Review, Inc., 1968. 653p.

The following topics are covered in 20 chapters: fifty years of Soviet physical chemistry, electron paramagnetic resonance, fused salts, electrochemistry, experimental inorganic thermochemistry, fast reactions in solutions, radiationless molecular electronic transitions, ligand substitution dynamics, vibrational and rotational relaxation, surface chemistry, ion–molecule reactions, mass spectrometry, lasers and their applications in physical chemistry, gas reactions yielding electronically excited species, statistical mechanics, vibrational spectroscopy, nuclear magnetic resonance, optical rotation, physical organic chemistry, and ^3He–^4He solutions. Separate abstracts were prepared for 5 chapters. (M.C.G.)

For abstracts of individual chapters see: 15805, 15872, 15873, 16764, and 16900.

15872 SURFACE CHEMISTRY. Somorjai, Gabor A. (Univ. of California, Berkeley). Annu. Rev. Phys. Chem., 19: 251-72 (1968).

The properties of "clean" solid surfaces are discussed. These include studies of surface structure, surface phase transformations, and the dynamics of surface atoms. Gas–solid interactions are also discussed. These include molecular beam scattering from well-defined surfaces, investigation of elementary steps of adsorption, and surface reactions. The techniques and nature of low-energy electron diffraction are discussed. (149 references). (M.C.G.)

15873 ION–MOLECULE REACTIONS. Friedman, Lewis (Brookhaven National Lab., Upton, N. Y.). Annu. Rev. Phys. Chem., 19: 273-300(1968).

Low-pressure experimental studies of isolated biomolecular reactive collision processes are discussed. Ion–molecule reactions at low pressures in a mass spectrometer ion source are reviewed. External source techniques, ion-cyclotron resonance mass spectrometry, and reactions of ions with controlled internal energy states are considered. (103 references). (M.C.G.)

Radiation and Nuclear Chemistry

Refer also to abstracts 15863, 16223, 16226, 16886, and 17084.

15874 (BNL-tr-255) RADIOCHEMICAL COPOLYMERIZATION OF STYRENE WITH ACRYLONITRILE IN THE CRYSTALLINE PHASE. Chapiro, Adolphe; Cordier, Pierre. Translated for Brookhaven National Lab., Upton, N. Y., from J. Chim. Phys., 64: 334-7(1967). 9p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 19651.

15875 (BNL-tr-256) MACROMOLECULES. ELECTRONIC MICROSCOPY OF THE RADIOCHEMICAL POLYMERIZATION OF TETRAOXANE MONOCRYSTALS. Cannavo, Christian; Deschamps, Jacqueline; Hayashi, Koichiro; Sella, Claude. Translated for Brookhaven National Lab., Upton, N. Y., from Compt. Rend., Ser. C, 266: 777-80(Mar. 11, 1968). 7p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 27815.

15876 (NSJ-tr-142) RADIATION-INDUCED POLYMERIZATION OF VINYL ETHERS. Naruse, Tsutomu; Fueki, Kenji; Kuri, Zen-ichiro. Translated from Kogyo Kagaku Zasshi, 70: 580-3 (Apr. 1967). 13p. Dep.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 21108. (TSS)

15877 (UCD-34-P-158-1) RECOIL STUDIES IN CHEMICAL DYNAMICS. Progress Report, January 1, 1968–December 31, 1968. (California Univ., Davis. Dept. of Chemistry). 11p. Dep. CFSTI.

Reactions of recoil tritium and recoil ^{18}F with 1,1,1-trifluoroethane were studied. Both processes led to hot molecules, which then undergo pressure-dependent unimolecular decomposition to 1,1-difluoroethylene. It was concluded that recoil fluorine reacts at much higher energies than recoil tritium. Reactions of recoil ^{18}F with cyclo-C_4F_8 and cyclo-C_3F_6 were also studied. Recoil experiments with n-perfluoroalkanes demonstrated that no F for F abstraction takes place, that F for F substitution does take place probably at high energies, and F for perfluoroalkyl radical reactions are more important than the analogous reactions in the tritium–hydrocarbon systems. It is shown that the $^{23}Na(n,2n)^{22}Na$ reaction can be used to monitor the production of ^{18}F in recoil experiments. (M.C.G.)

15878 ACID-BASE EQUILIBRIA AND KINETICS OF THE SOLVATED ELECTRON AND ATOMIC HYDROGEN IN WATER. Stein, Gabriel (Hebrew Univ., Jerusalem). pp 87-97 of Hydrogen-Bonded Solvent Systems. Covington, A. K. (ed.). London, Taylor and Francis Ltd., 1968.

From Symposium on Equilibria and Reaction Kinetics in Hydrogen-Bonded Solvent Systems, Newcastle upon Tyne, Eng. See CONF-680117.

Thermodynamic and kinetic data concerning the equilibria

$$\begin{array}{l} \qquad\qquad + H^+_{aq} \\ H^+_{aq} + e^-_{aq} \rightleftharpoons H \rightleftharpoons H^+_{2aq} \\ \qquad\qquad + OH^- \\ \qquad H_2O + e^-_{aq} \end{array}$$

are critically surveyed. The structure and reactivity of the hydrated electron is examined in the light of these results. The reactivity of the hydrated electron with various reactants to produce atomic hydrogen is discussed and the question whether a Brønsted relationship applies to such reactions examined. It is shown that the Brønsted relationship does apply to those reactions of e^-_{aq} which involve proton transfer, but not to reactions which involve the addition of the hydrated electron to electrophilic centres. The reactions of atomic hydrogen in aqueous solution, as an acid and as a base are discussed. (auth)

15879 CALORIMETRIC INVESTIGATION OF RADIOINDUCED SOLID-STATE POLYMERIZATION OF N-PHENYLMETHACRYLAMIDE. Gol'danskii, V. I.; Plate, N. A.; Rapoport, V. B.; Shakhmaliev, A. M. Vysokomol. Soedin., Ser. B, 10: 646-50(Sept. 1968). (In Russian).

Polymerization of N-phenylmethacryiamide (PMA) by electron beams at 1.6 MeV was observed using an isothermal differential microcalorimeter. Electron paramagnetic resonance studies were made of the formation of free radicals on irradiation and of their extinction afterwards. The experiments were conducted at temperatures of 40 to 87°C. It was established that polymerization of solid PMA occurred only near the melting point. The rate of the reaction increased sharply in relation to the approach to the

melting point and changed very little after further increases in temperature. (tr-auth)

15880 APPLICATION OF THE METHOD OF RADIOTHERMOLUMINESCENCE TO THE APPRAISAL OF THE STRUCTURE OF BLOCK COPOLYMERS. Nikol'skii, V. G.; Zlatkevich, L. Yu.; Krol, V. A.; Petrov, G. N. Vysokomol. Soedin., Ser. B, 10: 691-3(Sept. 1968). (In Russian).

Radiothermoluminescence was used to study block copolymers of butadiene with styrene and butadiene with isoprene. It is shown that in relation to the dimension of the block, the block copolymers can be both homogeneous and heterogeneous. (tr-auth)

15881 THE EFFECT OF REACTOR NEUTRON IRRADIATION ON PROPERTIES OF FERROELECTRIC SINGLE CRYSTALS OF BARIUM TITANATE. Hilczer, Bozena (Inst. of Physics, Poznan, Poland). Poznan. Tow. Przyj. Nauk, Wydz. Mat.-Przyr. Pr. Kom. Mat. Przyr., 11: 197-215(1966). (In Polish).

The effect of reactor-pile neutron irradiation on the ferroelectric properties of $BaTiO_3$ was studied. Barium titanate in the ferroelectric state is characterized by appearance of domain structure, dielectric hysteresis loop, specific temperature dependence of permittivity, and delay effects in an electrical field. As usual in ferroelectrics these properties are related to domain reorientation processes, which are deteriorated by aging. Reactor-pile neutron irradiation of $BaTiO_3$ causes lattice defects whose number, density, and type depend on the integrated stream or spectrum of the neutrons irradiating the single crystals, and these defects affect the domain-reorientation phenomena. It was inferred that radiation defects from a flux of 10^{14} to 10^{19} n/cm^2 do not change the domain structure of $BaTiO_3$ (this also holds true for other ferroelectrics). These defects reduce the possibility of domain reorientation in an external electric field, as proven by experimental data. Irradiation changes the hysteresis loop with increase in coercive field and energy lost in magnetic reversal because of the rise in potential barrier between the possible domain orientations and reduction of their polarity; lag in a dc magnetic field also changes and sign reversal occurs in strong electric fields. Irradiation defects also reduce the mobility of interdomain walls. (JPRS)

15882 RADIOLYSIS OF BENZENE–BROMOBENZENE MIXTURES. Siegrist, Renato; Gaeumann, Tino (Institut de Chimie Physique, Lausanne, Switzerland). Chimia (Aarau), 22: 480-2 (Dec. 16, 1968). (In German).

The γ-irradiation of solutions of bromobenzene in benzene gives rise to formation of biphenyl in a yield of 70% related to the diminution of bromobenzene. The postulated reaction scheme allows both the G-value of the diminution of bromobenzene and the concentration of biphenyl to be calculated as functions of the dose. In the presence of additives two quantities can be calculated: the relative quenching of the additive, compared to bromobenzene, and the relative reactivity of the addition reaction of phenylradicals, compared to benzene. (auth)

15883 RADIATION-INDUCED H–T SUBSTITUTION IN BENZENE, CHLOROBENZENE, AND BROMOBENZENE. Kroh, J.; Burzynska, E. (Technical Univ., Lodz, Poland). Bull. Acad. Pol. Sci., Ser. Sci. Chim., 16: 509-13(1968).

The H–T substitution in γ-irradiated solutions of tritiated methanol in benzene, chlorobenzene, or bromobenzene was investigated. Comparison of the substitution and radical yields together with certain rate constants of the investigated compounds indicated that the process does not proceed by the radical mechanism. Most probably ionic species or/and excited molecules are involved in the substitution. Twenty one per cent of the tritium substituted in chlorobenzene is fixed in the meta position. (auth)

15884 DOSE AND CONCENTRATION DEPENDENCE OF HYDROGEN TRANSFER IN THE RADIOLYSIS OF DILUTE SOLUTIONS OF CYCLOPROPANE IN n-HEXANE AND CYCLOHEXANE. Rzad, Stefan J.; Schuler, Robert H. (Carnegie-Mellon Univ., Pittsburgh). J. Phys. Chem., 72: 228-36(Jan. 1968). (RRL-2310-206).

The radiation chemistry of ^{14}C-cyclopropane–hexane solutions has been studied in some detail over the concentration range 10^{-4} to 10^{-1} M in order to examine for possible chemical manifestation of the free-ion yield (~0.1) observed in conductivity experiments. In this system the predominant radioactive products, which appear to result from ion–molecule reactions, are propane formed by H_2 transfer (~50%) and by H transfer (~20%) and mixed nonanes (~30%). At the lower concentrations, very pronounced dose dependence of the yields were observed, which were interpreted in terms of competition of olefins formed in the radiolysis. Assuming a concentration dependence of the form $G = G_i + K\sqrt{[S]}$, a mathematical description of the dose dependence is given which allows extrapolation of the observed yields to zero dose and subsequent evaluation of the low-concentration limiting yield G_i. Similar, but less detailed, observations are also reported for cyclopropane–cyclohexane solutions, where the chemical processes seem to be considerably more complicated than for hexane solutions. The observed values of G_i for the yields of total radioactive products were ~0.05 and ~0.11, respectively, for hexane and cyclohexane. These limiting yields were of the order of magnitude of, and appeared to be related to, the free-ion yields in these systems. (auth)

15885 THERMAL DECOMPOSITION AND SZILARD–CHALMERS ANNEALING IN THE SOLID STATE. Jach, Joseph (State Univ. of New York, Stony Brook). J. Inorg. Nucl. Chem., 30: 919-30(May 1968).

The thermal decomposition and Szilard–Chalmers annealing of $NaBrO_3$ were studied over a range of temperatures very high for the annealing but quite low for the decomposition. It is concluded that the two processes may be intimately related, each throwing light on each other's mechanisms. The possible existence of exchange reactions in the solid state was demonstrated. (auth) (UK)

15886 A STUDY OF ELECTRON PARAMAGNETIC RESONANCE SPECTRUM ANISOTROPY OF AN IRRADIATED SINGLE CRYSTAL OF TRIGLYCINE SULFATE. Stankowski, J.; Dezor, A. Poznan. Tow. Przyj. Nauk, Wydz. Nauk, Wydz. Mat.-Przyr. Pr. Kom. Mat. Przyr., 11: 217-24(1966). (In Polish).

The angular relationship of the electron paramagnetic resonance spectrum of a single crystal of triglycine sulfate irradiated by ^{60}Co γ rays was studied with respect to the orientation and the isotropic constants of hyperfine cleavage and the anisotropic constant of hyperfine splitting of the CH bond are determined. The hyperfine anisotropic structure, width, and g-factor of the ERP spectrum of a TGS crystal $[(NH_2CH_2COOH)_3 \cdot H_2SO_4]$ was examined by changing the orientation of the specimen in relation to the direction of a dc magnetic field H. The orientation of field H in the orthogonal system of coordinates xyz connected with the specimen is determined by the directional cosines of vector H. Thus the spectra designated by the symbols [100], [010], and [001] are found in the case where dc magnetic field was parallel to correspond to the x, y, and z axes. On the basis of observations of the entire hyperfine splitting (this is the distance between the extreme components of the hyperfine structure expressed in Oersteds) a table of hyperfine structure values is set up whose elements correspond to different orientations of the dc magnetic field: $H_{[100]}$–99.0, $H_{[010]}$–82.0, $H_{[001]}$–81.0. The crystal studied displays an anisotropy of factor g. For accurate determination of this anisotropy a crystal of DFPH is cemented to a TGS crystal of microscopic size and the ERP is taken for the various crystal orientations. The g-factor is smallest in direction [010] and greatest in the zx plane (2.0020 and 2.0048, respectively). This result shows the external field acting on the unpaired electron is almost axial and its axis coincides with the polar axis of the crystal. (JPRS)

15887 ENERGY TRANSFER IN AROMATIC SOLUTIONS. PART I. Ehrl, A. (Gesellschaft fuer Strahlenforschung, Neuherberg, Ger.). Atomkernenergie, 14: 137-42(Mar.-Apr. 1969). (In German).

Cis- and trans-stilbene, dissolved in benzene, were isomerized by ^{60}Co-γ-irradiation. Finally an equilibrium with constant ratio between the cis- and trans-stilbene was reached, which was identical with the ratio obtained by uv-irradiation of the solutions under the same conditions. In the presence of anthracene the trans → cis-isomerization yield is reduced, but the cis → trans-isomerization is unaffected. The investigation of the fluorescence behavior of the unirradiated solutions of the same composition helped to explain the role of the solvent benzene and the dissolved anthracene with respect to the stilbene isomerization. In the presence of trans-stilbene the benzene fluorescence is quenched and the trans-stilbene fluorescence excited. The excitation energy is therefore transferred from benzene to trans-stilbene. In the presence of anthracene the fluorescence of the benzene and trans-stilbene is quenched and only the fluorescence of anthracene appears. The energy therefore is transferred from benzene via trans-stilbene to anthracene. Only the energy transfer from the solvent to the dissolved stilbene affects the isomerization and not the quantum energy of the used radiation. Anthracene quenches the excited trans-stilbene and reduces therefore its isomerization yield. Since cis-stilbene does not fluoresce, there is no influence of anthracene on its isomerization yield. (auth)

15888 CHEMICAL REACTIONS RESULTING FROM HEAVY PARTICLE BOMBARDMENT OF DIAMOND. Zeller, Edward J.; Dreschhoff, Gisela (Univ. of Kansas, Lawrence). Contract AT-(11-1)-1057. Z. Naturforsch., 23a: 953-4(1968). (COO-1057-39).

Irradiation of natural diamond crystals with protons, ^{3}He nuclei,

and deuterons ranging in energy from 0.7 to 1.5 MeV produced infrared absorption bands apparently related to the formation of hydrocarbons. (M.C.G.)

15889 RADIATION PROCESSED FIBRE–POLYMER COMBINATIONS. Mani, R. S.; Jayaraman, T. M.; Thacker, R.; Aggarwal, K. S. (Bhabha Atomic Research Centre, Trombay, India). Indian J. Technol., 7: 16-23(Jan. 1969).

The possibility of treating cheaper varieties of wood and other fibrous materials like bamboos and bagasseboards by radiation polymerization of the plastic monomers inside the fiber structure, so as to improve their mechanical strength and durability, was investigated. The fiber–polymer combination was achieved by first soaking the material in a suitable plastic monomer, after which it was polymerized by exposure to gamma rays, avoiding high temperatures and the use of catalysts. Pronounced improvements in appearance, toughness, hardness, abrasion resistance and dimensional stability were achieved. Plasticizers, catalysts or naturally occurring polyesters like dehydrated castor oil were added to styrene in varying proportions. A technique based on preheating the impregnated sample prior to irradiation or using preheated styrene itself for impregnation was found to reduce the radiation dose requirement to 3.5 MRads. Comparative studies using the thermocatalytic and radiation techniques were carried out and optimum conditions worked out for the production of fiber–polymer combinations using styrene. (auth)

15890 PULSE RADIOLYSIS OF AQUEOUS SOLUTIONS OF DEOXYRIBONUCLEOTIDES AND OF DNA: REACTION WITH HYDROXYL-RADICALS. Scholes, G. (Univ. of Newcastle upon Tyne, Eng.). Chem. Commun., No. 1, 17-18(1969).

The pulse-radiolysis technique has enabled some of the primary radiolytic events which can occur in systems comprising dilute aqueous solutions of nucleic acids and related compounds to be studied directly. The spectral and decay characteristics of transients formed from the reaction of OH radicals with such solutes were investigated, and results are given for solutions of purine and pyrimidine deoxyribonucleotides and calf thymus DNA. Single 0.2 μ sec pulses of 1.8 and 4 MeV electrons were used in the studies, the dose being ~1.5 kR/pulse. Optical measurements of the pulsed solutions were confined to wavelengths >300 nm, because of the strong optical absorption of the solutions themselves below this wavelength. The transients were studied in nitrous oxide saturated solutions, the N_2O scavenging solvated electrons and approximately doubling the yield of available OH radicals. Optical absorption spectra are shown for the transients from solutions of the 5′-deoxyribonucleotides of adenine, guanine, thymine and cytosine, and also deoxyribose-5′-phosphate. The results indicated that absorptions at wavelengths >300 nm were mainly due to radical reactions with the heterocyclic base components. Studies of DNA solutions were carried out in the presence of phosphate buffer to prevent denaturation; spectra for these solutions are also shown, and indicated that transients again arose from attack on the base components of the polynucleotide. The spectra from the pulsed polynucleotide solutions were compared with a weighted average spectrum of the separate mononucleotides; results confirmed that the observed transient absorption is essentially associated with attack on the base components of the polynucleotide. The effect of multiple pulsing was also examined, in relation to increased transient yield. Results and mechanisms are discussed. (UK)

15891 THE EFFECT OF RADIOACTIVE ^{35}S ON THE STABILITY OF Fe PHTHALOCYANINE–$BaSO_4$ CATALYST IN THE DECOMPOSITION OF HYDROGEN PEROXIDE. Spitsyn, Vikt. I.; Dobroselskaya, N. P.; Rudenko, A. P. Dokl. Akad. Nauk SSSR, 183: 1135-8(1968). (In Russian).

Fe phthalocyanine and $BaSO_4$ were mixed in an agate mortar. The specific surface was measured by krypton absorption, and the specific activity by 4π beta counting. The decomposition rate of a 3% H_2O_2 solution was measured from the volume of evolved oxygen at 50°C. The catalyst stability as expressed by the number of moles of decomposed H_2O_2 per mole of decomposed Fe phthalocyanine varied from 330 moles for the nonradioactive catalyst to 360, 389, 408, and 477 moles of H_2O_2 for the radioactive catalysts with increasing activity. A noticeable increase in the stability of the radioactive catalyst as compared to the nonradioactive catalyst was noted. Control experiments showed that radiation had no effect on the decomposition of hydrogen peroxide. It is hypothesized that the excitation of the hyperaromatic system in Fe phthalocyanine by ionizing radiation slows down the decay of an intermediate, activated complex, and thus, favors the stability of the radioactive catalyst. (TTT)

15892 SORPTION OF KRYPTON AND FAST NEUTRON IRRADIATION DAMAGE IN SYNTHETIC MORDENITE AND SYNTHETIC FAUJASITE. Rees, L. V. C.; Khalid, M. S. (Imperial Coll. of Science and Tech., London). pp 319-27 of Molecular Sieves. London, Society of Chemical Industry, 1968.

From Conference on Molecular Sieves, London, Eng. See CONF-670455-2.

The sorption of krypton in synthetic mordenite was studied over the temperature range 25 to −150°. Analysis of the isotherms showed that the heat of sorption decreased slowly with coverage due probably to the existence of two different sizes of channels in this zeolite. When only the monolayer region was considered, sorption was found, as in a previous study with synthetic faujasite, to be localized with mutual interactions occurring between sorbate molecules. When synthetic mordenite was irradiated with fast neutrons, the sorption of krypton was found to be a sensitive method of assessing fine changes in the channel structure. Irradiation was found to produce a contraction of the lattice, initially, followed finally by complete lattice collapse. Synthetic mordenite required smaller dosages of fast neutrons than synthetic faujasite to produce complete lattice collapse, and this was ascribed to the higher Si/Al ratio in synthetic mordenite. (auth) (UK)

15893 TECHNICAL PROGRESS IN WOOD-POLYMER AND OTHER FIBER-POLYMER COMBINATIONS AROUND THE WORLD. Mott, William E. (Atomic Energy Commission, Washington, D. C.); Stannett, Vivian T. Isotop. Radiat. Technol., 6: 323-36(Spring 1969).

Worldwide activities on wood–polymers and other polymer-containing fibrous materials are reported, with emphasis on the technical rather than the economic and natural-resources aspects of the subject. Developments are reported for active or projected programs in 25 countries. (75 references). (P.C.H.)

15894 AROMATIC AND INNER SHELL IONS: INERT AND DESTRUCTIVE SPECIES IN RADIATION CHEMISTRY. Hamlet, Peter Leon. Los Angeles, Univ. of California, 1968. 75p. Thesis.

The chemistry of $C_6H_6^+$ was examined to help explain why benzene and other aromatic compounds show less radiation damage in the condensed phase than do other hydrocarbons. A mass spectrometric study was performed on benzene at pressures up to 1 torr. Ground state $C_6H_6^+$ ion is inert in gaseous benzene and is rapidly formed by electron transfer from C_6H_6 to benzene fragment ions such as $C_4H_4^+$. These results were confirmed by making fragment ions selectively through the use of electron transfer reactions from benzene to rare gas ions. To avoid radiation damage in liquid benzene, the inert $C_6H_6^+$ ions produced by γ radiolysis must avoid decomposition in the very exothermic process of charge recombination. It was suggested that electron capture by benzene would sufficiently slow the electron's return to the cation to permit nondestructive dissipation of the recombination energy via a charge transfer complex made from $C_6H_6^+$ and $C_6H_6^-$. This process of protection could be distinguished from mere intrinsic stability of benzene by determining if an ion which is known to undergo dissociative recombination with electrons could be protected in benzene. Radiolysis experiments showed that benzene did protect tetramethylethylene cation. The concept of nondestructive neutralization of an inert $C_6H_6^+$ by $C_6H_6^-$ thus accounts for the low level of radiation damage to liquid benzene. The knowledge obtained in the benzene work about electron transfer reactions from hydrocarbons to rare gas ions was also used to study a very destructive radiation chemical phenomenon: the production of $C_{20}H_{40}$ from solid methane. Radiolysis of liquid argon-methane solutions showed that in mixtures containing 0.15 mole % CH_4, a polymer averaging $C_{22}H_{42}$ was produced with a G value 11 times that for the polymer from pure methane. It is suggested that the polymer is formed by condensation of a dense blob of methane fragments produced by an Auger electron emitted following inner shell ionization. Strong support for this view was obtained by calculations that showed that the fractions of γ energy going to inner-shell ionization of argon and methane respectively were also in an 11 to 1 ratio. (Disser. Abstr.)

15895 EFFECT OF THE ADDITION OF OLEFIN IN THE (ALTERNATE) COPOLYMERIZATION OF ETHYLENIMINE AND CARBON MONOXIDE BY AIBN OR γ-RAYS. Kagiya, Tsutomu; Fukui, Kenichi (Kyoto Univ.). Nippon Kagaku Seni Kenkyusho Koenshu, No. 24, 75-82(Sept. 1967). (In Japanese).

The effects of various additions of olefins were studied in the copolymerization of ethylenimine and carbon monoxide by α,α'-azabisisobutyronitrile (AIBN) or radiation. The results are reported of the studies on the copolymerization reactions of aziridine derivatives and carbonyl compounds such as cyclic ester, cyclic imide, or carbon monoxide (new processes for producing polyamides). A copolymerization was found to occur in all cases, yielding a polyamide. While the process is unique, the procedure was established for producing nylon 24 or 3 with carbon monoxide. As

an extension of the studies, a new method was also developed for producing a copolyamide by a polyaddition reaction. (NSA of Japan)

15896 EFFECT OF THE ADDITION OF ETHYLENE IN THE γ-RAY ALTERNATE COPOLYMERIZATION OF ETHYLENIMINE AND CARBON MONOXIDE. Kagiya, Tsutomu; Fukui, Kenichi (Kyoto Univ.). Nippon Kagaku Seni Kenkyusho Koenshu, No. 24, 58-63(Sept. 1967). (In Japanese).

As an extension of the studies on the copolymerization reactions of aziridine and various cyclic compounds, it was found that aziridine and carbon monoxide alternate-copolymerize by γ irradiation to yield poly-β-alanine. The effect of addition of ethylene in this copolymerization reaction was studied. It was shown by elementary analysis, paper chromatography, infrared spectrometry, and x-ray diffraction that ethylenimine, carbon monoxide, and ethylene copolymerize under γ irradiation, to yield a polymer having in its main chain $+CH_2CH_2NHCO+$, $+CH_2CH_2CO+$, and $+CH_2CH_2CH_2CH_2NHCO+$. (NSA of Japan)

15897 ELECTRON BEAM EXPOSURE OF SILICONES. Yatsui, Yasuo; Nakata, Toshitake; Umehara, Kazuo (Sanyo Electric Co., Ltd., Osaka). J. Electrochem. Soc., 116: 94-7(Jan. 1969).

An investigation was carried out on silicone etch-resists, which can be exposed by electron beam irradiation. Thin silicone films with a thickness of about 5000 and 10,000 Å were irradiated by scanning electron beam accelerated at 10 and 25 kv, over defined area. The thicknesses of silicone films after development were measured for each different irradiation charge density; thus the exposure characteristics of a few kinds of silicones were obtained. With the most sensitive silicone, methylvinylpolysiloxane, it was possible to form a developed pattern with an irradiation charge density 8.8×10^{-7} coulombs/cm² at 10 kv. The chemical resistances of the electron-beam-irradiated silicone films to the chemical reagents that were thought to be the constituents of common etchants were also investigated. It was shown that flood-beam irradiation onto the developed silicone films was effective to increase chemical resistance and adhesive force to the substrate. Such silicone resists are practically useful to almost all etchants other than sulfuric acid. (auth)

15898 RADIOLYSIS OF METHYLCYCLOHEXANE. I. EFFECTS OF TEMPERATURE AND ELECTRON SCAVENGERS ON HYDROGEN FORMATION. Kimura, Toyoaki; Miyazaki, Tetsuo; Fueki, Kenji; Kuri, Zen-ichiro (Nagoya Univ., Japan). Bull. Chem. Soc. Jap., 41: 2861-6(Dec. 1968).

The effects of temperature and electron scavengers on the hydrogen yield in the radiolysis of methylcyclohexane have been investigated by conventional kinetic techniques. The G-value for hydrogen formation from pure methylcyclohexane varied from 4.9 to 4.4 in the range from room temperature to liquid nitrogen temperature. In the iodobenzene–methylcyclohexane system, the decrease in hydrogen yield was equal to the yield of benzene produced within experimental error. It was concluded that the benzene is formed through H atom abstraction from the solvent molecules by phenyl radicals which are formed by dissociative electron attachment to iodobenzene and that the benzene yield indicates the scavenged electron yield. Furthermore, a kinetic treatment for electron scavenging in the glassy state was presented. In the N_2O–methylcyclohexane system, it was found that the ratio of the nitrogen yield, $G(N_2)$, to the decrease in hydrogen yield, $\Delta G(H_2)$, is 2 in the temperature range from room temperature to –140°C, 1 at –160°C, and increases from 1 to 4 with increasing N_2O concentration at –196°C, respectively. (auth)

15899 RADIOLYSIS OF HYDROGEN CYANIDE IN AN AQUEOUS SYSTEM. II. EFFECTS OF ADDITIVES AND REACTION MECHANISM. Ogura, Hajime (Tokyo Metropolitan Univ.). Bull. Chem. Soc. Jap., 41: 2871-6(Dec. 1968).

The ^{60}Co γ irradiation of dilute aqueous solutions of hydrogen cyanide (6 mmoles) in the absence of oxygen yielded mainly ammonia with G = 1.9, formaldehyde with G = 1.1, and carbon dioxide with G = 0.8, while G(–HCN) = 5.8 molecules per 100 eV. Polymeric hydrogen cyanide was also observed with the G(–HCN (polymer)) ≃ 4, which showed an intense broad absorption band in the UV region upon γ irradiation. The following material balances were observed with the main products: G(–HCN) ≃ $G(NH_3)$ + G(–HCN(polymer)) ≃ $G(CO_2)$ + G(HCHO) + G(–HCN (polymer)). The results can be interpreted in terms of a mechanism involving HCN^-, H_2CN, and H(OH)CN radicals. The ratio of the rate constants for the reactions of e^-_{aq} and H atoms with hydrogen cyanide to those with several scavengers have been determined as $k(e^-_{aq} + HCN)/k(e^-_{aq} + NO_3^-) = 0.019$ and k(H + HCN)/k (H + 2-propanol) = 1.4, all at 17°C. (auth)

15900 γ-RADIOLYSIS OF A BINARY MIXTURE OF METHANOL AND WATER. THE FORMATION OF FORMALDEHYDE IN THE RADIOLYSIS OF LIQUID METHANOL. Seki, Hiroshi; Nagai, Reiko; Imamura, Masashi (Inst. of Physical and Chemical Research, Saitama, Japan). Bull. Chem. Soc. Jap., 41: 2877-81 (Dec. 1968).

The γ radiolysis of a binary mixture of methanol and water over a wide concentration range has been investigated. The observed yields of products are expressed as a linear function of the electron fraction of methanol in the mixture. The yields of molecular hydrogen were also determined. Analyzing the results on reasonable assumptions, $G^w_{e_f^-} = 2.3 - 2.5$ and $G^w_{OH} \geq 2.6$, could be obtained for neutral water. It was concluded that, in the radiolysis of methanol, formaldehyde may be produced through the decomposition of CH_2OH radicals in the spur region, not by the disproportionation of these radicals. (auth)

15901 ESR AND OPTICAL STUDIES OF THE REACTION INTERMEDIATES PRODUCED FROM PHENYL HALIDES BY DISSOCIATIVE ELECTRON ATTACHMENT IN γ-IRRADIATED ORGANIC GLASSES AT 77°K. Noda, Syozi; Fueki, Kenji; Kuri, Zen-ichiro (Nagoya Univ., Japan). Bull. Chem. Soc. Jap., 41: 2882-6(Dec. 1968).

ESR and optical studies have been made of dissociative electron attachment by phenyl halides and reaction intermediates produced in γ-irradiated glassy solid matrices at 77°K. Dissociative electron attachment by phenyl halides is an efficient process and the ratio of cross sections $C_6H_5I/C_6H_5Br/C_6H_5Cl$ for this process in methyltetrahydrofuran (MTHF) glass is 1.5/1.0/1.0. The phenyl radical produced abstracts a hydrogen atom from the solvents MTHF and 3-methylpentane (3MP) at 77°K and is stable in aqueous alkali metal hydroxide glass. A part of 3MP radicals in a γ-irradiated solution of phenyl bromide in 3MP at 77°K disappear by a first-order process for which $k = 4.3 \times 10^{-2}$ min^{-1}. γ-Irradiated 3MP glasses containing phenyl halides exhibit the optical absorption spectra having characteristic absorption bands in the visible and uv region which are assigned to solute cations and hydrogen-adducts, respectively. (auth)

15902 REACTION OF BROMINE ACTIVATED BY ^{82m}Br ISOMERIC TRANSITION IN LIQUID AND SOLID BENZENE. Shinomiya, Chiro; Kishikawa, Toshiaki (Kumamoto Univ., Japan). Bull. Chem. Soc. Jap., 41: 3026(Dec. 1968).

Neutron-irradiated molecular Br was mixed with liquid and solid benzene and allowed to stand at the temperature of dry ice for 60 min, by which time almost all the ^{82m}Br had decayed to ^{82}Br. The inorganic radiobromine was then separated by means of extraction. To analyze the rate of growth of the organic yield in the liquid run, $OY^{\infty}_{obs} - OY^{\Delta t}_{obs}$ were plotted against Δt, where OY^{∞}_{obs} represents the ^{82}Br organic yield reached in solid system or the liquid system after all the ^{82m}Br had decayed to the ^{82}Br ground state, and where $OY^{\Delta t}_{obs}$ represents it at any time before the ^{82m}Br has completely decayed. The plot gave a straight line. The half-time of the reaction so obtained was 6.27 min. Correcting for the contributions of the activities of the ground-state ^{82}Br produced directly from radiative neutron capture and for those of the activities decayed from ^{82m}Br before mixing, the net organic yields (OY^{∞}_{net}) of 113.1 ± 15.6 and 34.0 ± 3.1 were obtained for the solid and liquid phases, respectively. (P.C.H.)

15903 INITIATION OF RADIATION ION POLYMERIZATION AND THE CHARACTERISTICS OF ITS GROWTH REACTIONS. Okamura, Seizo; Hayashi, Koichiro (Kyoto Univ.). Nippon Kagaku Seni Kenkyusho Koenshu, No. 24, 93-103(Sept. 1967). (In Japanese).

Studies are being made of the characteristics of initiation and growth reactions in radiation ion polymerizations by comparisons with those of catalyst ion polymerizations. Characteristics of radiation ion polymerization are the coexistence of ions and radicals in the initiation stage and a growth stage with large reaction velocity constants. (NSA of Japan)

15904 X- AND γ-RADIATION DAMAGE TO SINGLE CRYSTAL ANTHRACENE. Harrah, L. A.; Hughes, R. C. (Sandia Lab., Albuquerque, N. Mex.). Mol. Cryst., 5: 141-3(1968). (SC-R-68-1772).

A single crystal of anthracene was exposed in air to x radiation to doses of 2×10^8 and 8×10^8 rads. The irradiated crystal exhibited an increased optical absorption similar to that observed by Blum et al., (Molecular Crystals 3: 269(1967)) in gamma radiolysis. The ESR spectra were also the same. (M.C.G.)

15905 CHEMICAL FORM OF RADIOACTIVE PHOSPHORUS PRODUCED BY IN-PILE IRRADIATION OF ORGANIC SULPHUR COMPOUNDS IN AQUEOUS SOLUTION. Lo Moro, Antonino; Frediani, Sergio (Univ., Pisa, Italy. CAMEN, Pisa, Italy). J. Inorg. Nucl. Chem., 31: 605-12(Mar. 1969). (In French).

The chemical states of radiophosphorus produced by the

$^{32}S(n,p)^{32}P$ reaction during in-pile irradiation of aqueous solutions of some organic sulphur compounds were studied. It was demonstrated that the radionuclide is present in several species. By changing the irradiation conditions it was found that the percentages of the various phosphorus species depend on the neutron and gamma fluences. Such a dependence was observed for two different concentrations. It was concluded that the final chemical state of phosphorus is determined by two competitive actions: the oxidizing action of the radiations, and the chemical protection due to the material in solution. (auth)(UK)

15906 FORMATION OF ASPARTIC ACID FROM AQUEOUS MIXTURE OF FUMARIC ACID AND AMMONIA BY γ-IRRADIATION. Rai, Tokan; Shinagawa, Mutsuaki (Osaka Univ.). J. Nucl. Sci. Technol. (Tokyo), 6: 51-4(Feb. 1969).

Solutions containing fumaric acid and ammonium hydroxide in various mole ratios were irradiated with γ rays from a ^{60}Co source (3×10^4 R/hr). The formation of aspartic acid was detected by paper electrophoresis, and the amounts produced were determined by spectrophotometry. The relation between aspartic acid yield and radiation dose was examined, and found to attain about 12% at a dose of 3×10^6 R, though it depended on the amount of fumaric acid used. The mechanism of the reactions involved is discussed. (auth)

15907 METHOD FOR GRAFT-POLYMERIZING WITH RADIATION A CELLULOSE MATERIAL USING ALUMINA GEL AS A CATALYST. Kubota, Hiroshi (to Japan Atomic Energy Research Inst.). Japanese Patent 1968-22879. Oct. 2, 1968. Filed Mar. 6, 1965.

In the emulsion graft-polymerization using radiation of a cellulose material and vinyl monomer, alumina gel is used as a catalyst, not to reduce the graft activity and not to produce the homopolymer. (NSA of Japan)

15908 STUDIES ON HOMOPOLYMER SYNTHESIS WITH IRRADIATED DNA IN THE RNA POLYMERASE SYSTEM. Kroeger, Hans (Univ., Freiburg i. B.); Schuchmann, Lothar; Petersen, Eiko; Hagen, Ulrich. Biochim. Biophys. Acta, 142: 542-4(1967). (KFK-651).

The effects of γ and uv radiation on the primary ability of DNA from calf-thymus DNA on the production of Poly (A), Poly (U), and RNA were investigated. The effects of various doses of γ radiation are presented in tabular form, and small doses were found to lead to an increase in Poly (A) synthesis and high doses to a decrease. Similar effects were noted for Poly (U) synthesis but not for RNA synthesis. Both uv- and γ-irradiated DNA were found to be able to inhibit RNA synthesis on untreated DNA. However, when the treated DNA is added after synthesis is started with untreated DNA, there is evidence that there is competition for the polymerase between the two DNA samples. Corresponding evidence was noted for γ-irradiated DNA. Similar effects were noted for Poly (A) synthesis. The temperature dependence of the synthesis of Poly (A), Poly (U), and RNA in the presence of untreated and γ- and uv-irradiated DNA is reported. (B.L.M.)

15909 USES OF HIGH-ENERGY RADIATION FOR THE MODIFICATION OF CELLULOSE FIBERS. 2. Okada, Toshio (Japan Atomic Energy Research Inst., Tokyo). Kobunshi Kako, 17: 567-71(Aug. 1968). (In Japanese).

Recent work in Japan on the modification of cellulose fibers by high-energy radiation is reviewed. Work on the following items is discussed; graft-polymerization of styrene onto regenerated cellulose fibers such as polynosic, etc., graft-polymerization of organosilicon oil on cotton cloth to increase water repellency; and graft-polymerization of butadiene–styrene, butadiene–acrylonitrile, and acrylic acid onto cellulose fibers for producing elastic yarn. (NSA of Japan)

15910 POLYMERIZATION OF N-VINYLPHTHALIMIDE BY γ-RAY RADIATION. Murata, Kenichi (Government Industrial Research Inst., Osaka). Osaka Kogyo Gijutsu Shikenjo Kiho, 19: 195-8(July 1968).

The polymerization of N-vinylphthalimide (VPI) in solid and in solution by γ radiation was studied. Vinylsuccinimide (VSI) was also polymerized in the solid state for comparison. VPI was comparatively difficult to polymerize; and the resulting polymer crystals were soluble in several solvents, including DMF, chloroform, etc. The irradiated monomer and polymer crystals of VPI were similar in external appearance, both anisotropic. In the solution polymerization of VPI in dimethylformamide (DMF), VPI was polymerized easily, unlike that in the solid state. The reduced viscosity of the resulting polymers was nearly independent of the irradiation time; the viscosity decreased with the dose rate. (NSA of Japan)

15911 ^{15}N-RECOIL REACTIONS IN OXYGEN. Statnick, R. M.; Kashihira, N.; Schmidt-Bleek, F. (Purdue Univ., Lafayette, Ind.). J. Inorg. Nucl. Chem., 31: 878-81(Mar. 1969).

NO has been reported as a product from the reaction of recoil ^{16}N with molecular oxygen. In a study of the reactions of ^{15}O with molecular nitrogen $^{14}N^{15}O$ was not observed as a product. Since reaction (1) does not occur the product distribution of recoil nitrogen incident upon molecular oxygen was re-investigated. $^{15}O(^3P) + N_2 \rightarrow {}^{14}N^{15}O + {}^{14}N(^2D) + \frac{\Delta R}{3.3}$ eV $^{13}N(^2D) + O_2 \rightarrow {}^{13}N^{16}O + {}^{16}O(^3P) - 1.36$ eV to determine the yield of $^{13}N^{16}O$ formed via reaction (2). (auth) (UK)

15912 CHEMICAL BEHAVIOR OF ^{51}Cr RECOIL ATOMS PRODUCED BY LOW TEMPERATURE IRRADIATION. Yeh, Si Jung (National Tsing Hua Univ., Taiwan, China); Shibata, Nagoa; Amano, Hiroshi; Yoshihara, Kenji; Yang, Mo-hsing; Chen, Ping Yao; Ke, Chin Nan; Kudo, Hiroshi. J. Nucl. Sci. Technol. (Tokyo), 6: 75-80(Feb. 1969).

Magnesium chromate anhydride, magnesium chromate monohydrate, and sodium chromate quadrahydrate were irradiated in the Liquid Nitrogen Temperature Loop at the Japan Atomic Energy Research Institute to study the behavior of ^{51}Cr recoil atoms. The initial retentions of recoil ^{51}Cr were measured at −55, −40, and −30°C, and the thermal annealing behavior of recoil ^{51}Cr was examined extensively in the temperature range from −20 to 80°C. The effects of difference in total irradiation dose and of the water of crystallization on the annealing behaviors of ^{51}Cr recoil atoms are discussed. (auth)

15913 SOLID STATE POLYMERIZATION IN BINARY SYSTEMS. Hardy, Gy.; Varga, J.; Nagy, G. Budapesti Musz. Egyet. Tud. Ulesszak, 2: 53-65(1967). (In Hungarian).

The mechanism of solid state polymerization in binary systems, namely in monomer–inhibitor and monomer–inert additive systems was studied. Solid state copolymerization was investigated in monomer–monomer binary systems. The effect of crystallization conditions on solid state polymerization was also studied. The monomers were: N-vinylsuccinimide, acrylamide, trioxane, 3,3′-bis(chloromethyl)oxetane, the radical inhibitor was benzoquinone, the inert additive succinimide, the comonomer N-vinylpyrrolidone. Phase diagrams and crystallization conditions of the binary systems were determined by means of polarization optical methods. Copolymerization was initiated with a ^{60}Co radiation source, the samples were irradiated in sealed deoxygenized ampoules. Polymerization was recorded gravimetrically. The results indicate that under otherwise identical conditions different rates of solid state polymerization can be achieved by subjecting the physical structure to crystallochemical influences. Crystallization conditions play an important role in the polymerization of binary solid systems. (Hung. Tech. Abstr.)

15914 REACTIONS OF $HON(SO_3K)_2$ WITH e^-_{aq}. Fel, N. S.; Zolotarevskii, V. I.; Zakatova, N. V.; Sharpatyi, V. A. (Inst. of Electrochemistry, Moscow. Inst. of Chemical Physics, Moscow). Khim. Vys. Energ., 2: 376-7(July–Aug. 1968). (In Russian).

The kinetics of e^-_{aq} decomposition in alkaline solutions (pH 12) of various concentrations of potassium hydroxylamine disulfonate (HADS) were studied in order to learn more concerning the possibility of HADS reactions with the reducing component of e^-_{aq} radiolysis. Freshly prepared twice-recrystallized HADS in solutions saturated with nitrogen were irradiated in a linear accelerator with ~4-MeV electron beams with a pulse duration of ~1.8-μsec and 10^{22}-eV/cm³ sec doses. The curves obtained revealed e^-_{aq} reactions with HADS. Measurements along the wavelength λ = 540 nm revealed a short-life conversion product of HADS (half-conversion time ~25). However, this product did not interfere with the observation of the decomposition kinetics of e^-_{aq} at the wavelengths studied. (R.V.J.)

15915 EFFECT OF ADDITIVES IN THE RADIOLYSIS OF GASEOUS AMMONIA AT HIGH DENSITIES. Nishikawa, Masaru; Kuroda, Kazufumi; Matsuura, Niro (Tokyo Univ.). Bull. Chem. Soc. Jap., 42: 116-8(Jan. 1969).

The effects of additives and density on the radiolysis of ammonia at 140°C were studied over the density range 0.07 to 0.13 g/cc. The observation of a sharp decrease of G-values in the radiolysis of pure ammonia at d ~ 0.1 g/cc confirmed the result reported by Toi et al. (Radiation Res., 17: 399(1962)). The yields of hydrogen in the presence of ~1.5 mole % C_3H_8 were practically independent of density at G = 0.65 over the density range studied. $G(H_2)$ in the presence of C_3H_8, estimated by extrapolation to zero propane concentration, was also constant at G ≈ 5.7 at d ≈ 0.07 and 0.13 g/cc. These observations are discussed in relation to the mechanism for depression of G-values in the radiolysis of pure ammonia at higher densities. (auth)

15916 A COMPARATIVE STUDY OF ELECTRON CAPTURE BY SOLUTES IN γ-IRRADIATED 2-METHYLTETRAHYDROFURAN GLASS AT 77°K. Wakayama, Terunobu; Kimura, Toyoaki; Miyazuaki, Tetsuo; Fueki, Kenji; Kuri, Zen-ichiro (Nagoya Univ., Japan). Bull. Chem. Soc. Jap., 42: 266-8(Jan. 1969).

Spectrophotometric studies were made on the reactivities of N_2O, SF_6, and CO_2 with electrons in tetrahydro-2-methylfuran (MTHF) glass at 77°K and the results were compared with those in the liquid and gas phases. Studies were also made on the reactions of nitrous oxide with electrons by analyzing the final products in connection with the measurements of the reaction intermediates. The results showed that the electron attachment cross sections of SF_6, N_2O, and CO_2 differ in the solid phase, while they are the same in the liquid phase. It was also concluded that nitrous oxide reacts with an electron to form one nitrogen molecule in MTHF glass. (P.C.H.)

15917 CONDUCTION INDUCED BY ELECTRON BOMBARDMENT IN POLYMER FILMS. Martin, E. H.; Hirsch, J. (London Univ.). Solid State Commun., 7: 279-82(Feb. 1969).

Results of experiments to study current growth under excitation by penetrating electrons are briefly summarized. Using short pulses of nonpenetrating electrons the predominantly mobile carrier was found to be positive in polystyrene and negative in polyethylene terephthalate. The effective mobility is of the order 10^{-5} cm^2 sec^{-1} V^{-1} and the effective energy for carrier generation 500 eV at 1 mV cm^{-1} in both materials. (auth) (UK)

15918 RETENTIONS OF ^{18}F AND ^{128}I IN IODINE PENTAFLUORIDE. Schleiffer, J. J.; Adloff, J. P. (Centre de Recherches Nucleaires, Strasbourg). Radiochim. Acta, 10: 176-7(Dec. 1968). (In French).

Iodine pentafluoride was irradiated with fast neutrons to induce the formation of ^{18}F. After several distillations the ^{18}F activity was not reduced; there was still 100% retention. Studies showed that isotopic exchange would not account for the retention. Comparison of the nuclear process to a spallation reaction offered a possible mechanism for the retention. The irradiation of iodine pentafluoride with thermal neutrons induced ^{128}I. This activity also cannot be separated by distillation. The ^{128}I was distributed between IF_5 (70%) and IF_7 (30%). (J.S.R.)

15919 PULSE-RADIOLYSIS STUDIES. XIV. RATE CONSTANTS FOR THE REACTIONS OF HYDROGEN ATOMS WITH AROMATIC COMPOUNDS IN AQUEOUS SOLUTION. Neta, P.; Dorfman, Leon M. (Ohio State Univ., Columbus). J. Phys. Chem., 73: 413-17(Feb. 1969).

Absolute rate constants were determined for the addition of hydrogen atoms to aromatic compounds in water by observation of the formation rate curves of the cyclohexadienyl radicals. The values of these rate constants for the compounds studied are: C_6H_5COOH, 1.00×10^9; C_6H_5CN, 0.68×10^9; $C_6H_5NO_2$, 1.04×10^9; $C_6H_5SO_3H$, 0.82×10^9; $C_6H_5CH_2COOH$, 1.01×10^9; $C_6H_5COCH_3$, 1.10×10^9; p-Cl$-C_6H_4COOH$, 1.13×10^9; p-$NO_2-C_6H_4COOH$, 0.98×10^9; p-OH$-C_6H_4COOH$, 1.45×10^9 M^{-1} sec^{-1} at 25°. The uncertainty in these values is about ±15%. The specific rate constant for the reaction of hydrogen atoms with methanol, determined by competition kinetic with several of these compounds, is 1.6×10^6 M^{-1} sec^{-1} at 25°. The isotope effect for the reaction of H and D atoms with two of these compounds was found to be $k_H/k_D = 1.32 \pm 0.05$ for C_6H_5COOH and $C_6H_5SO_3H$. (auth)

Radiochemistry

Refer also to abstract 16339.

15920 (MLM-1581) COMPUTER MODEL OF THE AUTOREDUCTION OF $^{238}Pu(VI)$ UNDER THE INFLUENCE OF ITS OWN α-RADIATIONS. Silver, G. L. (Mound Lab., Miamisburg, Ohio). Feb. 12, 1969. Contract AT-33-1-GEN-53. 23p. Dep. CFSTI.

The autoreduction of hexavalent ^{238}Pu under the influence of its own alpha radiations can be simulated by adjusting the rate of reduction of Pu(IV) by radiation-generated reducing agents and the rate of proportionation of Pu(III), Pu(IV), and Pu(VI) via the equation $3Pu(IV) \rightarrow 2Pu(III) + Pu(VI)$. (auth)

15921 CHEMICAL EFFECTS OF ELECTRON CAPTURE IN $^{57}Co(III)(1,10\text{-PHENANTHROLINE})_3(ClO_4)_3.2H_2O$. Jagannathan, R.; Mathur, H. B. (National Chemical Lab., Poona). Inorg. Nucl. Chem. Lett., 5: 89-96(Feb. 1969).

Moessbauer studies have indicated the presence of nonequilibrium states of iron formed in the electron capture decay of ^{57}Co due to the Auger process. If the reported results on the observation of the Fe^{3+} state, in addition to the expected Fe^{2+} state, were due to long relaxation times of the highly ionised states of iron, then the decay of ^{57}Co in a predominantly covalent matrix should not give rise to any appreciable percentage of the nonequilibrium higher charge states on account of a greater overlap of the ligand orbitals with the metal ion orbitals. In this connection the results of a study on the Moessbauer spectrum of the low-spin compound $^{57}Co(III)(1,10\text{-Phen})_3(ClO_4)_3 \cdot 2H_2O$ are reported. The Moessbauer spectrum at −194°C is shown graphically, matched against ^{57}Fe-enriched $K_4Fe(CN)_6 \cdot 3H_2O$ absorber at 25°C, and including a computed curve as a superposition of the two separate spectra due to low-spin Fe(III) and high-spin Fe^{2+} states. Values are also tabulated for isomer shifts, quadrupole splittings, line-widths, and percentage contributions to resonance absorption by each of the two components. Results are discussed. The observation of the low-spin Fe(III) is consistent with the conversion of the low-spin $^{57}Co(III)$ to low-spin $^{57}Fe(III)$. The observation of high-spin Fe^{2+} was, however, unexpected, since the Auger process provides no mechanism for the production of a lower valency state; an explanation may, however, be found in fragmentation of the molecule due to coulombic repulsion arising from the secondary Auger process following electron capture decay of ^{57}Co. (UK)

Separation Processes

Refer also to abstracts 15808, 15859, 15869, 16069, 16461, 16510, and 16522.

15922 (BNWL-702) DBBP SOLVENT EXTRACTION RECOVERY OF NEPTUNIUM AND PLUTONIUM FROM PUREX 1WW SOLUTION. Schulz, W. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 1969. Contract AT(45-1)-1830. 47p. Dep. CFSTI.

A batch solvent extraction process was developed to recover neptunium and plutonium values from Hanford Purex process 1WW solution. Dibutylbutyl phosphonate (DBBP) diluted with a mixture of normal paraffin hydrocarbons is used as the extractant. The utility and feasibility of the DBBP extraction process were fully demonstrated in laboratory scale tests with both synthetic and plant 1WW solutions. Plant scale tests of the process for possible eventual incorporation into the Hanford Purex process complex are recommended. (auth)

15923 (CEA-CONF-1094) TEST OF LEACHING OF URANIUM MINERALS WITHOUT PRELIMINARY GRINDING. Bodu, Robert; Sugier, Pierre; Chapot, Georges; Blachon, Guy. [1967]. 9p. (In French). (CONF-680644-1). Dep.

From 8th International Conference on Ore Dressing, Leningrad, USSR.

The recovery of U from submarginal products and minerals not exploitable by the standard methods is discussed. Industrial results obtained from 1963 to 1966 were encouraging in regard to a sensible augmentation of products by leaching in situ in all mining exploitations. Past experience has constituted new progress towards the simplification of methods for exploiting minerals and the replacement of hard work in standard mining methods. (P.C.H.)

15924 (CEA-CONF-1096) RECOVERY OF PLUTONIUM FROM SLAG AS THE FLUORIDE. Bourgeois, M.; Manevy, G.; Heyne, C.; Vanderchmitt, A. (Commissariat a l'Energie Atomique, Valduc (France). Centre d'Etudes). [1967]. 29p. (In French). (CONF-680938-1). Dep.

From Conference on the Chemistry of Plutonium, Valduc, France.

A procedure based on the elimination of plutonium from slags by volatilization of its hexafluoride was studied to evaluate the elimination of plutonium under different operating conditions with no concern for the purity of the product recovered. The principle of the fluorination procedure is discussed, and the tests made in vertical furnaces and rotating furnaces are described. The series of preliminary tests indicated that the elimination of plutonium by this procedure is very slow but nevertheless possible. (J.S.R.)

15925 (HW-77678) PUREX NEPTUNIUM RECOVERY AND PURIFICATION INFORMATION MANUAL. Duckworth, J. P. ([General Electric Co., Richland, Wash. Hanford Atomic Products Operation]). Apr. 1, 1963. 122p. Dep. CFSTI.

Equipment and operating information is furnished for the recovery and purification of neptunium. The extraction and decontamination of neptunium in the J-Cell Package is described. The purification of neptunium in the Q-Cell section of the building is covered. The aqueous makeup changes to the Purex plant are covered. (M.C.G.)

15926 (HW-84473) PUREX IBX: IBS COLUMN STUDIES, 1964. Richardson, G. L. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Oct. 29, 1964. Contract AT(45-1)-1350. 8p. Dep. CFSTI.

The pilot plant pulse column runs had three objectives: to develop a high-capacity cartridge for the Purex IBX column, to demonstrate the use of this cartridge under flow conditions typical of a proposed Thorex process flowsheet, and to determine the behavior of sodium formaldehyde sulfoxalate (SFS) and U^{4+} in the IBX-IBS system. Stable operation at volume velocities as high as 1620 gph/ft^2, sum of flows, was demonstrated in the IBX column under both Purex and Thorex flow conditions. Up to 70% dispersed-phase holdup in the column midsection was measured at maximum apparent efficiency. The path of SFS, and of the U^{4+} produced by its reaction with uranyl ions, was followed as a function of the SFS introduction point. The SFS was apparently completely reacted within a few inches of its feed point; U^{4+} was detected from about 6 ft below the SFS feed point to the top of the column, the concentration being nearly constant above the feed point. The use of SFS as a plutonium reductant in the IBX column is not recommended at this time because of its variable and unpredictable corrosion behavior. Stainless steel was reported to corrode at rates on the order of 1 in./month at 60°C in synthetic IBX column solutions containing SFS, although such a vigorous corrosion was observed in only one of the pilot plant runs. (auth)

15927 (KFK-783) ISOLATION OF ^{241}Am FROM PLUTONIUM SCRAP BY EXTRACTION WITH TRICAPRYLMETHYLAMMONIUM NITRATE. Koch, G.; Schoen, J. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Heisse Chemie). June 1968. 23p. (In German). Dep.

A method for the production of Am from scraps from preparation of plutonium-containing nuclear fuels was developed. The initial material is the americium-containing raffinate solution from the anion exchange column used for Pu recovery. From the solution concentrated by evaporation, the residual Pu and U were extracted with tricaprylmethylammonium nitrate (TCMAN) in an aromatic diluent. The aqueous solution freed of U and Pu was brought to 7M ammonium nitrate and to pH = 1.5 and the Am was extracted with TCMAN. The organic phase was washed with 7M ammonium nitrate. Am was re-extracted with 3M nitric acid, precipitated as the oxalate, and calcined to the oxide. The method was tested in the laboratory and yields a product of >99% purity. The Am loss was <2%. (tr-auth)

15928 (KFK-tr-260) FIXING RADIOACTIVE WASTE WITH CEMENT. Schejbalova, L.; Novotny, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Translated into German from report UJV-1609. 49p. (In German). Dep.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 8568.

15929 (MLM-1526) MOUND LABORATORY CHEMISTRY AND PHYSICS PROGRESS REPORT, JULY-SEPTEMBER 1968. (Mound Lab., Miamisburg, Ohio). Feb. 10, 1969. Contract AT(33-1)-Gen-53. 22p. Dep. CFSTI.

Research progress is reported on: the alpha-beta branching ratio of ^{227}Ac, electron transfer studies in thorium and uranium complexes with diketo ligands, recovery of ^{234}U from aged ^{238}Pu materials, recovery of ^{229}Th from ^{233}U, decontamination of ^{206}Pb, and the neutron energy spectrum of a ^{241}Am-Be(α,n) source. (M.C.G.)

15930 (MLM-1529) STABLE GASEOUS ISOTOPE SEPARATION AND PURIFICATION: JULY-SEPTEMBER 1968. (Mound Lab., Miamisburg, Ohio). Feb. 13, 1969. Contract AT-33-1-GEN-53. 56p. Dep. CFSTI.

Research progress is reported on: separation of carbon isotopes; separation of stable isotopes of neon, argon, krypton, and xenon; transport properties and column properties in thermal diffusion; and ^{3}He distillation, superfluid separations, and thermal transpiration. (M.C.G.)

15931 THE MECHANISM OF MOLYBDENUM(VI) EXTRACTION FROM HYDROCHLORIC ACID SOLUTIONS BY OXYGEN-CONTAINING SOLVENTS. Busev, A. I.; Frolkina, V. A.; Koroleva, M. Ya. (Moscow State Univ.). Zh. Anal. Khim., 24: 205-9(Feb. 1969). (In Russian).

It was found by the Ostromyslenski-Job method and by the spectroscopic method in the infrared and ultraviolet regions that molybdenum dihydroxydichloride is extracted by the oxygen-containing solvents from hydrochloric acid solutions. These results are in agreement with the data of the chemical analysis of the extracts for molybdenum and chloride. It was also found by the method of infrared spectroscopy that molybdenum dihydroxydichloride is solvated in the organic phase by the molecules of water and organic solvent. (auth)

15932 SOLVENT EXTRACTION OF IRON(III) WITH 1-PHENYL-3-METHYL-4-BENZOYLPYRAZOLONE-5. SEPARATION OF PLUTONIUM FROM IRON. Chmutova, M. K.; Kochetkova, N. E. Zh. Anal. Khim., 24: 216-20(Feb. 1969). (In Russian).

A study has been made of the extraction of the chelate compound of iron(III) with 4-benzoyl-3-methyl-1-phenyl-2-pyrazolin-5-one (BMPP) from nitric, hydrochloric, and sulfuric acid solutions. Iron is quantitatively extracted by a 0.1 M solution of BMPP in benzene from 1 to 6.5 N HNO_3 at a long phase contact. During the extraction from HNO_3 the time necessary for equilibrium to be established is lesser, the higher the HNO_3 concentration. The complete and rapid extraction of iron can be attained from 7 N HNO_3. The effects of the BMPP concentration, foreign complexing agents, and the concentration of iron on its extraction from HNO_3 have been studied. During the extraction from H_2SO_4 and HCl solutions a minimum was observed on the extraction curves (at 4 to 5 and 6 to 6.5 N acid concentrations correspondingly) which disappeared at a longer phase contact in the first case and did not disappear in the second case. Iron was quantitatively extracted from 1 to 9 N H_2SO_4 and 1 to 2 N HCl at a long phase contact, and from 11 N HCl rapidly. A method has been developed for separating iron from plutonium. After extracting plutonium and iron from 7 N HNO_3 by a 0.1 M solution of BMPP in benzene, plutonium is eluted with 10.8 N HCl, iron remains in the organic phase. Some other methods for separating iron from plutonium are also suggested. (auth)

15933 NEW DEVELOPMENTS IN FUEL REPROCESSING. (PART 1). Kraak, W. Atoomenergie Haar Toepass., 10: 262-70(Nov. 1968). (In Dutch).

The currently used fuel reprocessing methods are briefly described. Two reprocessing plants are currently in operation in Europe at The Hague and Mol; three smaller ones are nearing completion at Saluggia, Rotondella, and Karlsruhe. All of these plants use the wet leaching process, preceded by a mechanical treatment (chop-leach) or chemical treatment. The wet processes represent a variant of the U. S. Purex process. A critical study of the various extraction and separation processes pointed out the merits of the dry volatility method. Fluoride volatilization appears to be more economical than acid leaching but the method is not sufficiently reproducible for commercial application. It is expected that in the near future hybrid processes, such as G. E.'s Aquaflor process will be introduced. Pyrotechnical methods, salt-transport, and salt cycle processes which are not ready yet to be used on a large scale, are also mentioned. (Review article, 24 references). (TTT)

15934 THE AMALGAMATION BEHAVIOR OF HEAVY ELEMENTS. IV. THE TRACER CHEMISTRY OF DIVALENT MENDELEVIUM. Maly, Jaromir (Univ. of California, Berkeley). J. Inorg. Nucl. Chem., 31: 741-54(Mar. 1969).

It is shown that the extraction of medelevium into sodium amalgam from sodium acetate solutions results in about a ten-fold enrichment relative to the lighter actinides (Pu, Am, Cm, Bk). Separation of Md from the heavier actinides may be accomplished by either of two methods: (1) an amalgam containing Md, Fm, Es, and Cf can be decomposed in cold concentrated HCl and then the Md may be coprecipitated with $EuCl_2$ with one order of magnitude enrichment from Fm; (2) Md can be separated by electrolysis in acetate or citrate-acetate solution on an electrode of mercury amalgamated with sodium. In the lanthanide series, method (2) is used to separate Eu or Sm from the other rare earths. The sequence of electrodeposition of actinides in acetate-citrate solution is Md > Fm > Es > Cf. These separation methods probably depend on the formation of stable Md^{2+}. The potential of the $Md^{3+} + e \rightarrow Md^{2+}$ couple was estimated by a series of reductions, using $YbCl_2$, Zn, $EuCl_2$, $CrCl_2$, VCl_2, and $TiCl_3$, all in 2M HCl. All except $TiCl_3$ appear to reduce Md^{3+} to Md^{2+}, which can then be coprecipitated with $EuSO_4$ or $BaSO_4$; Md is thereby enriched 10 to 30× in the precipitate, relative to the daughter isotope ^{256}Fm in solution. (auth) (UK)

15935 THE SOLVENT EXTRACTION OF HAFNIUM(IV). VIII. EXTRACTION OF Hf(IV) BY SOME DIALKYLPHOSPHORIC ACIDS FROM BROMIDE, IODIDE, AND SULPHATE MEDIA. Navratil, O. (Faculty of Natural Sciences, Brno). J. Inorg. Nucl. Chem., 31: 855-66(Mar. 1969).

The distribution of $^{175+181}$Hf(IV) between aqueous hydrobromic, hydroiodic, and sulfuric acid and a solution of dibutyl-, di-n-pentyl-, diethylhexyl-, and di-n-octylphosphoric acids in various organic solvents was studied. In moderately acidic solutions of halogen-acids Hf is extracted as $HfX_3(HA)_x$, where HA is the dialkylphosphoric acid and X is the halogen. In strong acidic solutions the originally ion-exchange extraction mechanism was replaced by an addition type of reaction with the formation of extractable complexes of the composition $HfX_4(HA)_y$. In sulfate solutions, with the exception of dioctylphosphoric acid, complexes of the $HfA_4(HA)_y$ type were extracted in moderately acidic medium, and in strong

acidic medium the extraction mechanism was again changed and solvated sulfate complexes of Hf were formed. (auth) (UK)

15936 ISOTOPE EQUILIBRIUM IN THE SYSTEM BF_3–TETRAHYDROPYRAN COMPLEX OF BF_3. Katal'nikov, S. G.; Ngo Kuok Byu (Moscow Chemical-Technical Inst.). Isotopenpraxis, 4: 386-8(Oct. 1968). (In Russian).

A complex of BF_3 and tetrahydropyran cyclic ether was used to separate the boron isotopes by chemical exchange. Some physical characteristics of tetrahydropyran such as density and viscosity were measured over the temperature range from 15 to 45°C. In addition, the molar fractions of BF_3 and tetrahydropyran in the complex were determined thus making it possible to evaluate the separation coefficient α. The latter was measured at temperatures ranging from 15, 25 to 35°C. Furthermore, the isotope exchange equilibrium constant of the same system was calculated. (auth)

15937 THE SEPARATION OF NITROGEN AND OXYGEN ISOTOPES BY ADSORPTION ON SYNTHETIC ZEOLITES. Kocurichin, V. E.; Zel'venskii, Ya. D. (Moscow Chemical-Technical Inst.). Isotopenpraxis, 4: 388-91(Oct. 1968). (In German).

The high values of the separation factors in the adsorption of hydrogen isotopes on zeolites indicate that adsorption is an effective method of separating isotopes. Measurements were made of the single-stage separation factors of the nitrogen and oxygen isotopes by adsorption of molecular nitrogen and molecular oxygen on several zeolite types in the temperature range from 77 to 100°K. (auth)

15938 THE DETERMINATION OF THE CHARACTERISTIC OF A CHROMATOGRAPHIC COLUMN FOR THE SEPARATION OF ISOTOPES BY FRONTAL ANALYSIS. Botter, F.; Tistchenko, S. (Centre d'Etudes Nucleaires de Saclay, Essone, France). Isotopenpraxis, 4: 392-400(Oct. 1968). (In French).

A frontal chromatographic technique was used to separate the hydrogen and neon isotopes by gas–solid-chromatography. The chromatograms obtained allowed to calculate the single-state separation factors for these isotopes and to determine the height equivalent theoretical plateau (HETP). These parameters are of importance in projecting the corresponding production plants. (auth)

15939 USE OF ZONE MELTING FOR PURIFICATION OF IRRADIATED NUCLEAR FUELS. Ammon, Reinhard v. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Nukleonik, 9: 65-9(1967). (In German). (KFK–556).

Experiments were carried out for purification of the potential nuclear fuel UCl_4 from fission products and other impurities. In all cases the impurity distributed strongly towards the molten zone, thus moving towards the end of the sample. After 20 passes at a velocity of 10 mm/h separation factors were obtained between $c/c_0 = 10^{-4}$ and 5×10^{-2} in the following order: $RuCl_3 < BaCl_2 < CsCl < CeCl_3 < NaCl < ZrCl_4$. Tracer concentrations show the same behavior as higher concentrations (0.1 to 1 wt %). Zone refining of the UCl_4–KCl eutectic (44 mole % UCl_4) yielded less favorable results. Separation factors under comparable conditions are smaller by 1 to 2, for $RuCl_3$ even 3 orders of magnitude. $ZrCl_4$ was the only compound distributing towards the solid phase, but only if present in macroconcentrations. (auth)

15940 SURFACE DEPLETION IN THE VACUUM DISTILLATION OF METALS FROM BISMUTH. Bradley, R. F.; Webster, D. S. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Nucl. Sci. Eng., 35: 159-64(Feb. 1969).

Surface depletion was investigated in laboratory- and plant-scale distillation units with mixing by natural convection or by mechanical surface agitation. During the distillation of ^{210}Po, Zn, Cd, Te, and Mg from bismuth at 650 to 750°C, surface depletion was significant for the more volatile components: ^{210}Po, Zn, and Cd. The extent of surface depletion was decreased by relatively intense agitation of the entire liquid-metal surface. A model was developed for predicting the degree of surface depletion during the distillation of metals from bismuth as a function of temperature, still pot dimensions, and degree of agitation. (auth)

15941 SEPARATION OF RARE METALS FROM MOLYBDENUM CONCENTRATES. Airapetyan, G.; Gukasyan, Zh.; Meliksetyan, A. Prom. Arm., Sov. Nar. Khoz. Arm. SSR, Tekh.-Ekon. Byull., No. 6, 13-15(1967). (In Russian).

Up to 20% of the Mo and all of the Re, Se, Te, Bi, Cu, Fe, and S are transferred into the mother liquor on breakdown of Mo concentrates by HNO_3. Neutralization with ammonia to a pH value of 2.5 to 3.4 precipitates up to 94% of the molybdenum as iron molybdate. For combined precipitation of Se, Te, or Bi, with $Fe(OH)_3$ with yields of 97, 75, and 100%, respectively, the best pH range was 6.5 to 8.0. (M.C.G.)

15942 EXTRACTION OF URANIUM(VI) FROM HYDROCHLORIC ACID SOLUTION BY TRI-n-OCTYLAMINE IN BENZENE. Kojima, Takashi; Fukutomi, Hiroshi; Kakihana, Hidetake (Tokyo Inst. of Tech.). J. Nucl. Sci. Technol. (Tokyo), 6: 81-9(Feb. 1969).

The distribution ratios obtained in the extraction of U(VI) from aqueous hydrochloric acid solutions by tri-n-octylamine (TOA) in benzene have been measured in varying concentrations of TOA, HCl and U(VI). The effects on extraction behavior brought by variations of chloride ion and water concentration in the organic phase have also been examined. The extraction mechanism is discussed with consideration given to the aggregation of TOA salt of HCl in benzene and the formation of uranyl chloro-complex in the aqueous phase. It was concluded that under low U(VI) loading, the extraction is represented by the equation $3TOA \cdot HCl(org) + UO_2^{2+}(aq) + 2Cl^-(aq) = (TOA \cdot HCl)_3UO_2Cl_2(org)$, while under relatively high U(VI) loading, the extraction expressed by the equation: $2TOA \cdot HCl(org) + UO_2^{2+}(aq) + 2Cl^-(aq) = (TOA \cdot HCl)_2UO_2Cl_2(org)$ can no longer be neglected. (auth)

15943 EXTRACTION OF NITRIC ACID BY TBP SOLUTIONS IN ORGANIC SOLVENTS. Shehata, M. K. K.; Aten, A. H. W. (Instituut voor Kernphysisch Onderzoek, Amsterdam). J. Inorg. Nucl. Chem., 31: 239-41(Jan. 1969).

Studies were made on the behavior of organic TBP solutions in extractions from aqueous nitric acid, in particular to determine which part of TBP is bound to nitric acid and which part is in the free state. Solutions of TBP in benzene, carbon tetrachloride, and chloroform were used. Distribution coefficients of HNO_3 were measured and from the K_{HNO_3} values actual acid distribution coefficients were calculated. The values found for this quantity were remarkably constant. (P.C.H.)

15944 SOLID–GAS CHROMATOGRAPHY OF METAL CHLORIDES. Stumpp, E. (Univ., Tuebingen, Ger.). Z. Anal. Chem., 242: 225-33(1968). (In German).

It has been found that graphite is a suitable stationary phase for the separating metal chlorides by the technique of solid–gas chromatography. For the separations an all-Pyrex construction was used. The detector was of the heat-conductivity type with platinum filaments. A special construction permitted injection of the solid metal chlorides. Helium was used as carrier gas. The following mixtures were separated on a 2.5 m column filled with synthetic, highly purified graphite (grain size 0.4 to 0.5 mm): $AlCl_3/GaCl_3$ at 300°C, $NbCl_5/ZrCl_4$ at 310°C, $TaCl_5/NbCl_5$ at 275°C, $NbCl_5/NbOCl_3$ at 450°C, $HfCl_4/ZrCl_4$ at 300°C, $AlCl_3/HfCl_4/ZrCl_4$ at 310°C. (auth)

15945 CALCULATIONS OF COEFFICIENT OF ISOTOPE SEPARATION DURING MOLECULE IONIZATION. Basov, Yu. G. (Moscow State Univ.). Zh. Fiz. Khim., 43: 456-7(Feb. 1969). (In Russian).

Formulas were derived for isotopic separation in the following systems: H_2-HD, H_2-D_2, $HD-D_2$, $^{14}N_2-{}^{14}N^{15}N$, $^{14}N_2-{}^{15}N_2$, $^{14}N^{15}N-{}^{15}N_2$, $^{16}O_2-{}^{16}O^{18}O$, $^{16}O_2-{}^{18}O_2$, $^{16}O^{18}O-{}^{18}O_2$, $^{14}N^{16}O-{}^{14}N^{18}O$, $^{14}N^{16}O-{}^{15}N^{16}O$, $^{12}C^{16}O-{}^{12}C^{18}O$, $^{12}C^{16}O-{}^{13}C^{18}O$, and CH_4-CH_3D. The coefficient of separation for a thermodynamic equilibrium system, $\lg a = 5040/T(V_{j_1} = V_{j_2})$ (where a is the coefficient of separation, T is the temperature, and V_{j_1} and V_{j_2} are ionization potentials of isotopic molecules), was used for calculating coefficients of separation for the above systems. (R.V.J.)

15946 PROCESSING OF TANTALUM METAL AT SHIN-ETSU CHEMICAL COMPANY. Hiraishi, Ryuichi. Nippon Kogyo Kaishi, 84: 1029-31(July 1968). (In Japanese).

Tantalite ore is pulverized, treated by $HF-H_2SO_4-HCl-HNO_3$, and Ta is extracted into the organic phase of methyl isobutyl ketone by the continuous extractor of mixer-settler type, while Nb is left in the aqueous phase. Ta is separated from the organic phase as tantalum hydroxide and K_2TaF_7 by the treatment with NH_3 and KF, and the hydroxide is converted to the oxide by roasting. The Ta is reduced by contacting it with Na vapor. Metallic powders of various grain size can be obtained by control of temperature, time, and concentration. Flow sheets, purity, and grade of the final products are given. (NSA of Japan)

15947 URANIUM MILLING AND REFINING. Nishikido, Giichi; Takada, Shingo. Nippon Kogyo Kaishi, 84: 989-92(July 1968). (In Japanese).

A uranium milling and refining method for treatment of low-grade ore is described. In the leaching process, the leaching efficiency is increased by heating to ~120°C for 10 min during H_2SO_4 leaching. The uranium is extracted by a tertiary amine

diluted with kerosene, the resulting organic phase is shaken with 8N HCl, and then uranium is back-extracted with water. Using this solution, the U is electrolytically reduced. A continuous operation of the ion exchange method for U separation is described, and the operation can be stabilized by regulating the hydrolytic force to control the quantity of resin movement. Uranium metal shavings from processing operations are dissolved in HCl before extraction rather than HNO_3. (NSA of Japan)

15948 METHOD OF FLORINATING NUCLEAR FUEL WITH RECOVERY OF PLUTONIUM TETRAFLUORIDE AND URANIUM HEXAFLUORIDE. Camozzo, G.; Coenen, F.; Francesconi, A.; Pierini, G.; Schmets, J. J.; Stynen, A. (to United States Atomic Energy Commission). U. S. Patent 3,429,670. Feb. 25, 1969.

A method is provided for fluorinating nuclear fuel with a mixture of chlorine trifluoride and chlorine and/or chlorine monofluoride, in order to suppress the formation of plutonium hexafluoride. (AEC)

15949 SOLIDIFICATION OF LOW-ACTIVITY CONCENTRATED AQUEOUS WASTES. Doellgast, W. (Siemens AG, Erlangen, Ger.). Atomwirt., Atomtech., 14: 23-4(Jan. 1969). (In German).

In the disposal of radioactive waste concentrates, methods were used in which in a waste barrel only a relatively low solid fraction, bound with cement or bitumen, could be accommodated. Studies led to a simple, operationally safe, method which gives a high solid content of 180 kg dry material in a 200-l barrel. A drying installation depending on cylindrical drying was constructed. It is described briefly. (J.S.R.)

15950 URANIUM PROCESSING AND UF_6 CONVERSION TO UO_2 AT MITSUBISHI METAL AND MINING COMPANY. Ito, Yoshitaka. Nippon Kogyo Kaishi, 84: 1004-11(July 1968). (In Japanese).

Milling and refining methods for the low grade uranium ore developed at this company are summarized. Uranium is extracted from H_2SO_4 using 0.1 M D^2EHPA + TBP in kerosene and is back-extracted with Na_2CO_3. The resulting solution is electrolytically reduced. Uranium tetrafluoride is precipitated directly with 20% HF, and the UF_4 is reduced by Ca or Mg. For the production of uranium alloy as fuel material, a simultaneous reduction method of the mixture of UF_4 and salt of the element used as a component of the alloy is developed. Uranium dioxide powder is produced from the concentrate by TBP extraction and ADU method, and UO_2 with various properties is obtained by regulating operational conditions of thermal decomposition and reduction process. The production method of UO_2 by fused salt electrolysis in KCl–NaCl bath using uranyl chloride and uranyl fluoride as reduction materials is mentioned also. A study was carried out on the conversion of enriched UF_6 to enriched UO_2 powder by an improved ADU method. (NSA of Japan)

15951 URANIUM REFINING AND UF_6 CONVERSION TO UO_2 AT SUMITOMO METAL MINING COMPANY. Nakamura, Fumio. Nippon Kogyo Kaishi, 84: 998-1003(July 1968). (In Japanese).

Uranium is extracted from the aqueous phase containing 300gIU, 3N HNO_3, and 1N $NaNO_3$ with 30 Vol % TBP in kerosene by the use of an oscillating column. The separation factor of Th is ~34. After back-extraction with H_2O, ammonium polyuranate (APU) is precipitated by NH_3 gas treatment to yield APU that is easy to filter and that yields UO_2 powder of homogeneous grain size under 20 μ as a product. After fluorination to UF_4, metallic U of high purity is obtained by Ca reduction. In the conversion of slightly enriched UF_6 to UO_2, a method is applied in which UF_6 gas is blown into $Al(NO_3)_3$ and the resulting $UO_2(NO_3)_2$ is extracted with TBP. This new method can reduce the corrosive action of HF to stainless steel and the excess $Al(NO_3)_3$ is effective as a salting-out agent. The chemical purity and physical properties of the product prepared by these methods are given. (NSA of Japan)

15952 PAPER-CHROMATOGRAPHIC SEPARATION OF VANADIUM, TUNGSTEN, MOLYBDENUM, RHENIUM, AND IRON. Geyer, R.; Herrmann, W.; Bogatzki, B. Wiss. Z. Tech. Hochsch. Chem. Leuna-Merseburg., 9: No. 1, 1-4(1967). (In German).

V, W, Mo, Re, and Fe were separated by ascending development on FN6 paper that had been washed free from Fe with dilute HCl. Fermentation amyl alcohol–HCl–30% H_2O_2 solution (19:6:2) as solvent. A solution of 5% ethanolic pyrogallol was used as spray agent. At 20°, the solvent front advanced 22.5 cm in 20 hr, and the following R_f values (for the leading edges of the spots) were obtained–V, 0.11; W, 0.45; Mo, 0.72, Re, 0.90; and Fe 1.0. Descending development gave similar results. Experimental variables were tested with 1-μl samples of a solution 0.04M in $FeCl_3$, KVO_3, K_2WO_4, and K_2MoO_4 and 0.01M in $KReO_4$. The ranges of variables were: temperature, 15 to 45°; proportion of aqueous components to 19 vol of alcohol, 1 to 8 vol; proportion of HCl to H_2O_2, 1 to 5; HCl concentration, 4 to 12M. Separation improved with decreasing polarity of the alcohol in the mixed solvent. Hexanol gave the best separation, but it was slower than amyl alcohol. Methanol gave no separation. (P.C.H.)

15953 TREATMENT OF NUCLEAR FUEL REPROCESSING LIQUID WASTES BY FLOTATION METHOD. Mukai, Shigeru; Koyanaka, Yoshio (Kyoto Univ.). Suiyokaishi, 16: 530-5(Oct. 1968). (In Japanese).

As a part of the fundamental study on treatment of nuclear fuel reprocessing liquid wastes, preferential flotation was investigated for the selective removal of long-lived fission products such as ^{137}Cs, ^{90}Sr, ^{106}Ru, ^{144}Ce, and ^{95}Zr from simulated low or intermediate level radioactive waste solutions. By three stage preferential flotation using sodium oleate or octadecylamine acetate as collector and cupric ferrocyanide or ferric hydroxide as coprecipitant, 95% of ^{137}Cs, 87% of ^{90}Sr, and more than 98% of the mixture of ^{144}Ce, ^{106}Ru, and ^{95}Zr were removed, respectively. The whole amount of radioactive sludge of the 1000 ml simulated radioactive waste solution was 130 to 190 mg. (NSA of Japan)

15954 INVESTIGATION OF THE CHLORINATION REPROCESSING OF FUEL ELEMENTS. III. THE CHLORINATION OF URANIUM DIOXIDE–PLUTONIUM DIOXIDE SINTERED TABLETS AND SEPARATION OF PLUTONIUM CHLORIDE FROM URANIUM CHLORIDE BY VACUUM SUBLIMATION. Kanellakopulos, B.; Parthey, H. (Kernforschungszentrum, Karlsruhe, Ger.). Nukleonik, 12: No. 1, 1-3(Dec. 1968). (In German).

The separation of plutonium from uranium by fractional sublimation of the chlorides was investigated. Chlorination of the oxides was carried out with a $Cl_2–CCl_4–Ar$ mixture. By annealing the chlorination products predominantly UCl_4 in addition to $PuCl_3$ was obtained. By subsequent fractional sublimation it is possible to separate plutonium from uranium quantitatively. The reaction temperature, the temperature gradient, and the total pressure are important parameters in the separation. (auth)

15955 RECOVERY OF LANTHANUM FROM DIDYMIUM CHLORIDE WITH DI(2-ETHYLHEXYL)-PHOSPHORIC ACID AS SOLVENT. Nair, S. G. K.; Smutz, M. (Ames Lab., Iowa). J. Inorg. Nucl. Chem., 29: 1787-97(1967). (IS-1442).

Lanthanum of about 99.8 percent purity was obtained from didymium chloride using two batch multistage countercurrent extraction cascades with 1 M D2EHPA as solvent. In the first cascade the La was concentrated in the raffinate, and in the second cascade the La was purified. The over-all recovery of La was 60 percent. Batch tests showed that the solvent could be reused repeatedly with no loss in extracting power. (auth)

15956 A SYSTEMATIC CATION EXCHANGE SEPARATION WITH OXALATE. Nozaki, Toru; Hiraiwa, Osamu; Henmi, Chujiro; Koshiba, Kunji (Ehime Univ., Matsuyama, Japan). Bull. Chem. Soc. Jap., 42: 245-7(Jan. 1969).

A systematic preliminary study was made of cation exchange separations of 19 metallic elements with oxalate as an eluting agent. Ranges of pH 2 to 5 and concentration 0.01 to 0.5 M were covered for the eluant. It was found that the 19 elements (Al, Be, Cd, Co, Cr, Cu, Fe, Ga, Hf, In, Mn, Ni, Pb, Sn, Th, Ti, U, Zn, and Zr) can be roughly classified into three groups according to their ion exchange behavior. As examples, mutual separations of several metals were carried out. (P.C.H.)

15957 PROCESSING OF TANTALUM METAL AT HIGASHI NAGAHARA PLANT. Komatsu, Akitoshi; Koyama, Keiji. Nippon Kogyo Kaishi, 84: 1027-9(July 1968). (In Japanese).

Tantulum ore (tantalite etc.) is leached with HF, and niobium and tantalum are separated by the extraction process with methyl isobutyl ketone. Using graphite crucible as anode, metallic Ta of high purity is obtained electrolytically from the Ta_2O_5 or K_2TaF_7 at a temperature of 800 to 900°C. The production capacity of this process is 1,000 kg/month. Metallic tantalum may also be produced by reduction of K_2TaF_7 with metallic Na of high purity. Eleven grades of Ta powder for condenser and 2 grades for metallurgy are manufactured as final products, and the flowsheets of each treatment and the grade and quality standard of the final product are stated. (NSA of Japan)

15958 METHOD OF PROCESSING NUCLEAR FUEL BY SELECTIVE CIF FLUORINATION WITH SEPARATION OF UF_6 AND PuF_4. Camozzo, G.; Coenen, F.; Francesconi, A.; Goossens, W.; Pierini, G.; Schmets, J. J.; Stynen, A. (to United States Atomic Energy Commission). U. S. Patent 3,429,669. Feb. 25, 1969.

Nuclear fuels are reprocessed by reacting them with chlorine

monofluoride, which converts the uranium in the fuels to volatile UF_6 and the plutonium to nonvolatile PuF_4. The chlorine produced in the reaction is separated from the UF_6 by distillation and reacted with fluorine to produce more chlorine and monofluoride. (AEC)

15959 REFINING OF URANIUM. Kiyosawa, Nobuhito. Nippon Kogyo Kaishi, 84: 993-8(July 1968). (In Japanese).

The uranium refining studies carried out at the Furukawa Electric Company, Ltd. are summarized. Domestic secondary ore is leached by sodium bicarbonate; the leach solution is acidified with H_2SO_4; and the uranium is extracted with Amberlite LA-2 diluted with kerosene. After back extraction, the solution of U is reacted with SO_2 in the presence of NH_4F to reduce the U and precipitate a mixture of UF_4 and NH_4F from which the UF_4 is obtained by thermal decomposition. The UF_4 is converted to metallic U by Mg reduction. Some U is received as yellow cake, which is dissolved in HNO_3, and the U is extracted with TBP and then back extracted with H_2O. Enriched UF_6 is treated by precipitating and separating the U as the ammonium diuranate, which is changed to U_3O_8 by roasting. The U_3O_8 is converted to UO_2 by reduction with H_2. (NSA of Japan) (TSS)

15960 METHOD OF, AND APPARATUS FOR, PURIFYING GASES CONTAMINATED WITH RADIOACTIVE SUBSTANCES. (to Siemens-Schuckertwerke Aktiengesellschaft). British Patent 1,141,196. Jan. 29, 1969. Priority date Feb. 17, 1965, Germany.

A method and apparatus are described for purifying gases contaminated with radioactive substances. The gas is heated and the moisture content is simultaneously increased. Then the gas is cooled and afterwards or simultaneously passed through dust extraction and/or filtering equipment. To increase the efficiency of the process, artificial condensation nuclei are supplied by means of electric corona discharges; by irradiation with uv light, which forms charge carriers; or by irradiation of the gas with a material that preferentially emits α particles and the radioactive series of which comprise no gaseous isotopes. The apparatus includes two filters alternately traversed by the gas to be purified and by air for the purpose of drying the filter in such a manner that when drying air is flowing through one filter, gas to be purified is flowing through the other. The dust extractor or filtering means is a helical flow dust extractor that is artificially cooled. (B.L.M.)

15961 ION EXCHANGER, WHICH CONTAINS PHOSPHORUS IN THE FUNCTIONAL GROUP; PRODUCTION AND PROPERTIES OF A CATION EXCHANGER DERIVED FROM 2-(4-HYDROXY-BENZOYL) BENZOIC ACID. Marhol, M. (Inst. fuer Kernforschung, Prague); Sykora, V.; Dubsky, F. Collect. Czech. Chem. Commun., 33: 3715-25(Nov. 1968). (In German).

Two types of cation exchanges, one of which contained phosphorus in the functional group, were prepared and their sorption characteristics determined under static and dynamic conditions in nitric acid medium as well as in mixtures of acetic acid and sodium acetate. The high selectivity of the phosphonium derivative for thorium and uranyl ions makes it suitable for the quantitative separation of these ions from various mixtures. (tr-auth)

15962 FACILE SEPARATION OF URANIUM FROM ^{238}Pu FOR ISOTOPIC URANIUM ANALYSIS. Silver, Gary L. (Monsanto Research Corp., Miamisburg, Ohio). Anal. Chem., 41: 548-9(Mar. 1969).

A method of separating plutonium and uranium by homogeneously precipitating the latter in the presence of Pu(III) with H_3PO_2 is described. Where ^{234}U can be determined by other techniques, this method allows an indirect determination of ^{232}U. The method was used to determine the $^{232}U/^{234}U$ ratio in several samples of plutonium, and the results compared with those obtained by an ion exchange procedure. The advantages of the precipitation method are simplicity (the isolation of the U involves little more than a series of evaporations and this can be done rapidly) and the problem of recovering ^{238}Pu from irradiated and partially decomposed ion exchange resins does not arise. Disadvantages include the inconvenience of contaminating the ^{232}U and ^{234}U with carrier ^{238}U and natural ^{234}U, and the possible generation of dangerous amounts of explosive phosphine within the confines of an alpha box. (D.H.M.)

EARTH SCIENCES

Geology and Hydrology

Refer also to abstracts 15997 and 16557.

15963 (BNWL-999) TEST SIMULATION OF POTENTIAL EFFECTS OF THERMAL POWER PLANTS ON STREAMS IN THE UPPER MISSISSIPPI RIVER BASIN. Peterson, D. E.; Jaske, R. T. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec. 1968. Contract AT(45-1)-1830. 81p. Dep. CFSTI.

The 1964 thermal regimen of the Upper Mississippi River and eight major tributary streams were simulated with the COL HEAT digital model. The potential impact of 1980 and year 2000 power requirements were simulated under the assumption of flow through cooling of steam generating plants. The results indicate that by the year 2000 few, if any, plant sites will remain along the Mississippi River where flow through cooling can be exclusively utilized for 1,000 MW units. (auth)

15964 (CEA-R-3431) COUNT RATE BALANCE METHOD OF MEASURING SEDIMENT TRANSPORT OF SAND BEDS BY RADIOACTIVE TRACERS. Sauzay, Guy (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1968. 168p. (In French). Dep.

Thesis. Submitted to Univ. of Toulouse, Faculte des Sciences, France.

Radioactive tracers were applied to the direct measurement of the sediment transport rate of sand beds. The theoretical measurement formula was derived; the variation of the count rate balance is inverse of that of the transport thickness. Simultaneously the representativity of the tracer was critically studied. The minimum quantity of tracer which has to be injected in order to obtain a correct statistical definition of count rate given by a low number of grains "seen" by the detector was then studied. A field experiment was made to study the technological conditions for applying this method. Only the treatment of results is new, the experiment itself was carried out using conventional techniques. (auth)

15965 (KURRI-TR-1) LOG OF INTERIOR RADIOACTIVE MONITORING. I (1964). Tsujimoto, Tadashi; Hayashi, Fumikazu; Matsuda, Yoshihiro; Sumino, Teruie; Nerai, Teruhiko; Kitagawa, Yoko; Katsurayama, Yukinori (Kyoto Univ. (Japan). Research Reactor Inst.). 1965. 28p. (In Japanese). Dep.

The facilities of the Kyoto University Reactor Research Institute are monitored in conformance with the provisions of the law on safety regulations pertaining to nuclear reactors. The record of the monitoring program for 1964 is presented. The measurements consisted of dose rate measurements, determination of the surface contamination, radioactive dust counting, and monitoring the waste water and the off-gas for radioactive contamination. Any unusual results were rechecked. Dose rates were measured with both a GM survey meter and a scintillation survey meter to cover the differing radiation energy ranges. Surface contamination was determined by the smear technique using filter paper and a low background counter. No unusual incidents or surface contamination were experienced in the reactor building during the year. All water systems were provided with built-in detectors which relayed the survey count scalers. Radioactive dust was collected on filter paper and counted with a GM tube for β and γ radiation and a scintillator for α radiation. The air was passed through a flow-type ionization chamber for the continuous monitoring of the atmospheric radioactivity. The data are summarized in seven tables. (TTT)

15966 (NTS-64) GEOLOGY OF NORTHERN NELLIS AIR FORCE BASE BOMBING AND GUNNERY RANGE, NEVADA. Ekren, E. B.; Anderson, R. E.; Rogers, C. L.; Noble, D. C. (Geological Survey, Denver, Colo.). June 27, 1966. 268p. Dep. CFSTI.

The geology of a 24,000 sq mile area in Nye county, Nevada was studied, and the geologic formations identified as to age, composition, and method of formation. It was concluded that among several localities within the area identified as providing favorable environments for underground nuclear testing, two large alluvium-filled basins, Kawich Valley and Gold Flat, are particularly suited for this purpose, and contain clay, gravel, and sand that is very similar to the testing media of Yucca Flat. (L.C.L.)

15967 ISOTOPIC CRITERION FOR DETERMINATION OF NATURAL HELIUM ORIGIN. Tolstikhin, I. N.; Kamenskii, I. L.; Mamyrin, B. A. (Inst. of Geology and Geochronology of the Precambrian, Leningrad. Physical-Technical Inst., Leningrad. All-Union Geological Oil-Prospecting Inst., Leningrad). Geokhimiya, No. 2, 201-5(Feb. 1969). (In Russian).

Isotopic analyses of He and Ar were carried out for samples of natural gas. The use of the two ratios, $^3He/^4He$ and He/Ar_{radiog} for the determination of helium origin is suggested. It was found that for gases which were formed among rocks rich in uranium and thorium the following ratios are characteristic: $^3He/^4He \leq 4 \cdot 10^{-8}$; $He/Ar_{radiog} \geq 20$. The correlation of the two ratios for the study of He gives more definitive results than their use separately. (auth)

15968 DIFFUSION OF RADIOACTIVE DECAY PRODUCTS IN MONAZITES. Voronovskii, S. N.; Magomedov, Sh. A. (Daghestan Branch, Makhachkala, USSR). Geokhimiya, No. 2, 185-91(Feb. 1969). (In Russian).

Experimental data for diffusion coefficients and activation energy of lead and helium isotopes in monazites from the Ukraine and Ceylon were obtained. Pyrochemical method of lead sublimation in the vacuum was used for lead separation. Its isotopic composition and quantitative content were determined mass-spectrometrically by the method of isotope dilution. The helium content was determined mass-spectrometrically by the internal standard method. It was found that practically all the lead is firmly bound in the crystal lattice of monazite. In regard to helium, the stable portion of the sample from the Ukraine was 10%, from Ceylon 38%. (auth)

15969 USE OF TRACER TECHNIQUE IN SOIL EROSION RESEARCH. McHenry, J. Roger (Sedimentation Lab., Oxford, Miss.). Isotop. Radiat. Technol., 6: 280-7(Spring 1969).

Techniques used to study erosion by tagging soil with radioactive tracers are reviewed. Several nuclides have been used for this purpose, e.g., ^{59}Fe, ^{46}Sc, ^{198}Au, and ^{51}Cr. Guidelines to be followed in the selection of a tracer are reviewed, and methods of incorporating the isotope on the material to be traced are described. Studies are discussed in which both the movement of single grains of sand and the bulk movement of the soil are followed. (auth)

Meteorology

Refer also to abstracts 15999, 16000, and 16085.

15970 (AD-672719) TRANSPORT CALCULATIONS PERTINENT TO SATELLITE DETECTION OF DELAYED GAMMAS FROM AN ATMOSPHERIC NUCLEAR EXPLOSION. Hubbard, H. W.; Marcum, J. I. (Rand Corp., Santa Monica, Calif.). June 1968. 44p. (RM-5626). CFSTI.

A solution to the problem of measuring the transmission of delayed fission product gamma rays from atmospheric nuclear explosions from source to detector. Assuming detection by a VELA satellite or equivalent, calculations were made by means of a modification of the RAND X-ray and gamma-ray Monte Carlo program (see RM-3595-PR). For each of ten equal angular zones, ranging from directly below the detector to the horizon, gamma fluxes were computed at two satellite altitudes — 110,000 and 35,000 km — for source heights of 55,000 ft, 65,000 ft, 75,000 ft, and 100,000 ft. Five thousand Monte Carlo histories were computed for each problem, requiring about 2.5 hours on the IBM 7044 for each. Numerical results are presented tabularly, in histograms, and with smoothed curves. Average standard deviation is 20 percent, and smoothing cuts it approximately 10 percent. A second run of 5000 histories was made for the 65,000-ft source, using a new set of initial random numbers, to check this deviation. Comparisons are made with results obtained using infinite medium buildup factors. (auth) (USGRDR)

15971 (AD-673202) OPERATION CENIZA-ARENA: THE RETENTION OF FALLOUT PARTICLES FROM VOLCAN IRAZU (COSTA RICA) BY PLANTS AND PEOPLE. PART III. Miller, Carl F. (Stanford Research Inst., Menlo Park, Calif.). Dec. 1967. 264p. (USNRDL-TRC-68-17(Pt.3)). CFSTI.

The derivation and evaluation of parametric scaling functions representing the retention of airborne particles by the foliage of various types of plants is presented on Operation Ceniza-Arena. The scaling functions include, as independent variables, wind speed, particle fall angle, planting density, plant weight, time after contamination, rainfall, and plant shape factors. The output parameters include the fraction of the horizontal component of the particle flux initially retained by the foliage, the relative amount

of the retained particles removed by wind-weathering, the relative amount of the retained particles removed by rain, and the rate of growth of plants (i.e., rate of accumulation of dry matter) with time after planting. Some data on the frequency distributions of plant weights and leaf areas and on the correlation between leaf area (or area of other plant parts) and the dry weight are presented. Approximating functions are presented for estimating the degree of particle retention by single trees and humans. The numerical evaluation of all the scaling functions was carried out using only the data obtained from the measurements made in Operation Ceniza-Arena during the period from March 1964 through February 1965. (auth) (USGRDR)

15972 (AD-673222) GROUND ROUGHNESS EFFECTS IN FALLOUT RADIATION FIELDS: PROBLEMS OF ANALYSIS OF MEASUREMENTS. Mather, R. L. (Naval Radiological Defense Lab., San Francisco, Calif.). Mar. 29, 1968. 65p. (USNRDL-TR-68-62). CFSTI.

The ground roughness effects on the gamma radiation field from fallout are calculated and described on the basis of the uniform burial model. The dose rate vs. height curves are estimated with an empirical function for the buildup factor. Graphs showing the effect of finite angular resolution of the measuring instrument and the observation of the angular distribution are presented. The emphasis is on an improved understanding of the meaning of a ground roughness and of the errors common in the measurement of that quantity. Methods of presentation and analysis of experimental data are discussed. (auth) (USGRDR)

15973 (CEA-R-3591) THE DISTRIBUTION, ATMOSPHERIC TRANSFER, AND ASSESSMENT OF ^{85}Kr. Pannetier, Raymond (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Nov. 1968. 180p. (In French). Dep.

Thesis. Submitted to Univ. of Paris, Faculte des Sciences, Orsay, France.

Techniques for sampling and measuring ^{85}Kr were developed which allowed the determination of its geographic distribution. From its use as a tracer, an evaluation of the air masses which cross the subtropical fronts was derived, and the stratospheric character of air pollution by ^{85}Kr at the level of the Antarctic soil was evaluated. Levels of ^{85}Kr seem to point to an underestimation of the assessment of nuclear explosion fission energies as adopted by the United Nations Scientific committee on the effects of atomic radiation and emphasize the need to set limits as soon as possible on the amounts of ^{85}Kr released to the atmosphere by fuel-processing plants. (auth)

15974 (EUR-4099) 9th METEOROLOGICAL YEARBOOK. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Jan. 1969. 94p. (In Italian). Dep.

A short description is given of methods for measuring and elaborating atmospheric phenomena. Tables and graphs for the meteorological year 1967 are presented. With the Observatory's data, temperature measurements at screen No. 4, 43 m lower, and the flow of the Novellino brook, are added. (auth)

15975 (SWRHL-22-r) OFF-SITE SURVEILLANCE ACTIVITIES OF THE SOUTHWESTERN RADIOLOGICAL HEALTH LABORATORY FROM JULY-DECEMBER 1964. (Public Health Service, Las Vegas, Nev. Southwestern Radiological Health Lab. National Center for Radiological Health, Rockville, Md.). Dec. 1968. 43p. Dep. CFSTI.

Off-site radiological surveillance for fifteen announced underground nuclear detonations and four reactor experiments during the period from July through December 1964, at the Nevada Test Site is described. This surveillance was conducted in the public areas surrounding the Nevada Test Site. Off-site radiological surveillance was also provided for an underground test conducted in Mississippi as part of the Vela Uniform program. During the six-month period, two announced nuclear events and four reactor experiments released radioactivity which was detected off-site. No radioactivity was released following the Project Salmon detonation in Mississippi. Analysis of all sampling and surveillance performed during the six-month period indicates that the safety criteria established by the Atomic Energy Commission for the off-site population were not exceeded. (auth)

15976 MEASUREMENT METHODS AND SOME RESULTS OF MEASUREMENT OF NATURAL RADIOACTIVITY OF THE AIR. Ittner, Ernst. Meteorol. Abh., Inst. Meteorol. Geophys., Freie Univ. Berlin, 72: No. 4, 35-40(1967). (In German).

Various radioactive substances are discussed, especially radioactive aerosols as well as their occurrence and behavior in the atmosphere. Some examples of meteorological influences on the amount of natural radioactivity are given. An explanation of the physical bases of emanometry and the different types of emanometers and modern measuring techniques are described. Finally information is given about measurements made with an emanometer; some of the results are compared with filter measurements. The relationship between the simultaneously observed data is discussed. (Meteorol. Geoastrophys. Abstr.)

15977 STUDIES OF THE RADIOACTIVE DUSTS IN AIR AT HIGH ALTITUDE. Igarashi, Shunji. Hoken Butsuri, 3: 386-92 (Dec. 1968). (In Japanese).

Radioactive dusts floating in the atmosphere over Japan at altitudes of between 10 and 12 km were collected with an airborne sampler mounted on aircraft. The collections were made during normal times and during nuclear testing. Measurement of radioactivity and ordinary chemical analysis were undertaken to make a comparative study of the differences between the radioactive dusts collected at two different times. It was found that the density of radioactivity in the air at the time of a nuclear test was about 500 times as high as at a normal time, whereas the density of the dusts in the air was the same at about 10 $\mu g/m^3$ at both times and the component elements of the dusts were Si, Fe, Al, Mg, etc., with no difference discovered. (NSA of Japan)

Mineralogy and Exploration

Refer also to abstracts 15814 and 16294.

15978 THERMOBARIC CONDITIONS OF HYDROTHERMAL URANIUM DEPOSIT FORMATION. Tugarinov, A. I.; Naumov, V. B. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya, No. 2, 131-46(Feb. 1969). (In Russian).

Pressures and temperatures of hydrothermal uranium deposit formation were determined by the methods of homogenization and decrepitation of gas-liquid inclusions. It was established that pressures during the formation of the deposits can substantially exceed the value of lithostatic load of overlying rocks. Ore stages of uranium deposits may form in a wide temperature range-at least from 350 to 50°, however a different form of uranium compounds corresponds to different temperatures. At temperatures above 250° uranium mineralization is represented by uraninite or brannerite. Where the chief ore mineral was pitchblende the temperatures of ore stages did not exceed 200 to 220°. (auth)

15979 URANIUM. Sherman, John T. (Atomic Industrial Forum Inc., New York). Eng. Mining J., 170: No. 3, 104-8 (Mar. 1969).

The U. S. uranium industry is discussed. Uranium exploration, reserves, enrichment, and requirements for U. S. power reactors are summarized. Acceptance of nuclear power and thermal pollution are discussed. Data are give on the uranium industries of Australia, Canada, Central Africa, and the Republic of South Africa. (F.S.)

15980 THORIUM. Stevens, Richard F. Jr. Eng. Mining J., 170: No. 3, 113-15(Mar. 1969).

Thorium mining, refining, stockpiling, nuclear and nonnuclear uses, price, exports, imports, demand, and the development of the thorium reactor concept are described. (F.S.)

Oceanography

Refer also to abstracts 15811 and 16072.

15981 (CU-3139-2) INVESTIGATIONS OF U AND Th SERIES ISOTOPE DISEQUILIBRIA IN THE OCEAN AND IN PLEISTOCENE SEDIMENTS. Annual Report. Broecker, Wallace S.; Kaufman, Aaron (Columbia Univ., Palisades, N. Y. Lamont-Doherty Geological Observatory). Oct. 1968. Contract AT(30-1)-3139. 189p. Dep. CFSTI.

Research progress is reported in six sections. A separate abstract was prepared for each section. (D.H.M.)

For abstracts of individual sections see: 15807, 15811, and 15982-15985.

15982 (CU-3139-2, App.A) DISTRIBUTION OF ^{228}Ra AND ^{228}Th IN THE OCEANS. Kaufman, Aaron (Columbia Univ., Palisades, N. Y. Lamont-Doherty Geological Observatory). 14p.

Analyses were completed for over one hundred seawater samples from many parts of the ocean for ^{228}Th. About twenty of these samples were analyzed for ^{228}Ra. Results are given that show the discernible distribution patterns and attempts to interpret the results in terms of sources of ^{228}Ra are made. Water mixing processes and thorium removal processes are also included. (auth)

15983 (CU-3139-2, App.B) ^{232}Th CONCENTRATION OF SURFACE OCEAN WATER. Kaufman, A. (Columbia Univ., Palisades, N. Y. Lamont-Doherty Geological Observatory). 32p.

Previous workers have reported ^{232}Th concentrations in surface seawater ranging from 0.3 to 0.6 μg/1000 l. Whereas these estimates were based on the analysis of single samples, work is presented based on a composite of 24 analyses of water collected from widely spaced parts of the ocean. A careful interpretation of the alpha spectrometer data indicates that the true concentration is less than 0.07 μg ^{232}Th/1000 l. As a result, previous discussions of thorium isotope residence times are put into doubt. (auth)

15984 (CU-3139-2, App.D) ACCUMULATION RATES OF MANGANESE IN PELAGIC SEDIMENTS AND NODULES. Bender, Michael; Ku, Teh-Lung; Broecker, Wallace (Columbia Univ., Palisades, N. Y. Lamont-Doherty Geological Observatory). 20p.

Manganese content was studied in about 30 dated cores. The results showed that within any depositional basin there was a very good correlation between Mn accumulation rate and total silicate deposition rate. This confirmed previous suggestions that the mechanism of Mn deposition is associated with silicate deposition. In addition, by comparing Mn accumulation rates in ordinary sediments with those of Mn nodules, it was found that they are of the same order of magnitude with the nodules having Mn accumulation rates about equal to those of cores from regions of lowest accumulation. (auth)

15985 (CU-3139-2, App.E) INSOLATION CHANGES, ICE VOLUMES AND THE ^{18}O RECORD IN DEEP SEA CORES. Broecker, Wallace S.; Van Donk, Jan (Columbia Univ., Palisades, N. Y. Lamont-Doherty Geological Observatory). 68p.

A thorough re-evaluation was made of the shape of the $^{18}O/^{16}O$ vs depth curves of several Atlantic and Caribbean cores and of the absolute ages of their most prominent features. When these were compared with the climatic record as revealed in high sea level stands, extents of continental ice sheets, pluvial lake levels, and pollen profiles, it was concluded that the $^{18}O/^{16}O$ curves were continuous records of the earth's climatic history. These curves are sawtoothed in shape, showing that ice accumulation lasts about ten times as long as melting and that the last four major periods of melting occurred 11,000, 125,000, 215,000, and 290,000 years ago. Superimposed on this major climatic cyclicity are minor fluctuations during which ice accumulation was temporarily reduced or enhanced. Finally, a comparison was made of this record of climatic history with the Milankovitch curves of orbitally caused fluctuations of solar insolation with time. This revealed that there is a definite correlation between the major climatic cycles and the seasonal contrast in insolation cycles and between the smaller climatic fluctuations and northern hemisphere. The $^{18}O/^{16}O$ record for Caribbean core V 12-122 was determined and it was found to be entirely compatible with those given by Emiliani (1966) for cores P 6304-8 and P 6304-9. Dating of deep sea cores by ^{231}Pa–^{230}Th and by magnetic reversals however, strongly suggests that the absolute time scale adopted by Emiliani (1966) for deep sea cores must be increased by 25%. (auth)

15986 ON OCCURRENCE FORMS OF IONIUM (^{230}Th) AND THORIUM (^{232}Th) IN THE OCEAN. Kuznetsov, Yu. V. Geokhimiya, No. 2, 177-84(Feb. 1969). (In Russian).

Collected data indicate that ^{230}Th and ^{232}Th are present in different forms not only in oceanic waters but also in other components of the oceanic system, in oceanic sediments and suspensions. It is assumed that most of the ionium in the ocean exists in hydrolytic forms which are sorbed on suspension particles while thorium is carried into oceans from continents in the composition of residual minerals. Significance of this conclusion in relation to the geochronology of oceanic sediments and the geochemistry of thorium in the ocean is considered. (auth)

Seismology

15987 TRANSMISSION AND ATTENUATION OF THE PRIMARY SEISMIC WAVE, 100 TO 600 KM. Long, Leland Timothy; Berg, Joseph W. Jr. (Oregon State Univ., Corvallis). Bull. Seismol. Soc. Amer., 59: 131-46(Feb. 1969).

The observed frequency dependence of attenuation can be used to calculate Q values which are independent of losses due to geometrical spreading or to reflections at boundaries. The observed apparent rates of attenuation in terms of Q_{ap} along two refraction lines were computed to be 169 ± 42 at 5 cps in eastern New Mexico and 116 ± 38 at 4 cps in Nevada. The geometrical spreading factor which satisfied the observed amplitudes and both of the observed Q_{ap} values is $r^{-0.5}$. Thus, the primary seismic wave at epicentral distances of 100 to 600 km would appear to be a continuous refraction (direct wave). Attenuation is the dominant factor in determining the waveform, spectral content, and amplitude of the first arrival. A Q of 100 implies a functional relation between frequency and distance which shows that amplitudes at frequencies above 4 cps at 150 km and above 3 cps at 400 km will be less than one tenth the peak spectral amplitude and cannot be reliably related to the source. (auth)

15988 SPECTRAL RESPONSE TO GROUND DISPLACEMENT AT HATTIESBURG RESULTING FROM NUCLEAR EVENT SALMON. Blume, John A. (John A. Blume and Associates, San Francisco). Bull. Seismol. Soc. Amer., 59: 229-44(Feb. 1969).

Spectral response is developed from principal portions of a record of ground displacement in Hattiesburg, Mississippi, resulting from the Salmon Event, Project Dribble, an underground nuclear explosion near Baxterville, Mississippi, in October 1964. No acceleration records are available for Hattiesburg. As a part of the study it was found that peak response in the important short-period range could be reasonably estimated using as little as one second of selected motion from the entire record, and that a simple stochastic model of this key portion of the ground motion essentially duplicated the peak response. (auth)

15989 INFLUENCE OF GEOLOGIC ENVIRONMENT ON SEISMIC RESPONSE. Alcock, E. D. Bull. Seismol. Soc. Amer., 59: 245-68(Feb. 1969).

A brief review is given of the state-of-the-art and the theory involved in the influence of geology on seismic response. Several field experiments are described which were performed to determine the dynamic amplification of seismic response by alluvium. In the Dry Lake area (saturated alluvium) resonant depths of alluvium were observed at 500 feet and 1400 feet. This is in approximately the harmonic ratio as predicted by theory. In the Hidden Valley area (dry alluvium) the resonant depth of alluvium was observed at 300 feet. The ratio of 500 feet to 300 feet for the two areas is in fair agreement with the ratio of 7000 feet to 5300 feet for the velocities of the alluvium in the two areas as determined by the refraction surveys. (auth)

15990 TRAVEL TIMES AND AMPLITUDES OF S WAVES FROM NUCLEAR EXPLOSIONS IN NEVADA. Nuttli, Otto W. (St. Louis Univ.). Bull. Seismol. Soc. Amer., 59: 385-98 (Feb. 1969).

The underground Nevada explosions Half-beak and Greeley were unique in creating relatively large amplitude and long-period body S waves which could be detected at teleseismic distances. Observations of the travel times of these S waves provide a surface focus travel-time curve which in its major features is similar to a curve calculated from the upper mantle velocity model of Ibrahim and Nuttli (1967). This model includes a low-velocity channel at a depth of 150 to 200 km and regions of rapidly increasing velocity beginning at depths of 400 and 750 km. Observations of the S wave amplitudes suggest that a discontinuous increase in velocity occurs at 400 km, whereas at 750 km the velocity is continuous but the velocity gradient discontinuous. Body wave magnitudes calculated from S amplitudes are 5.3 ± 0.2 for Greeley and 4.9 ± 0.2 for Half-Beak. These are about one unit less than body wave magnitudes from P amplitudes as reported by others. The shape and orientation of the radiation pattern of SH for both explosions are consistent with the Rayleigh and P-wave amplitude distribution of Bilby as given by Toksoz and Clermont (1967). This suggests that the regional stress field is the same at all three sites, and that the direction of cracking as well as the strain energy release in the elastic zone outside the cavity is determined by the regional stress field. (auth)

ENGINEERING

Nuclear Explosions

Refer also to abstracts 15970, 15973, 15975, 15987, 15988, 15990, 16029, 16057, and 16181.

15991 (AD-673530) MORE NUCLEAR EXPLOSIONS IN CAVITIES. Brode, H. L. (Rand Corp., Santa Monica, Calif.). June 1968. Contract F 44620-67-C-0045. 60p. (RM-5685-PR). CFSTI.

An extension of earlier calculations (in RM-3727) describing cavity gas dynamics and wall pressures and temperatures for low-yield nuclear explosions to include 10-kT explosions, 40-, 60-, and 80-meter-radius cavities, and a contained atmosphere of water vapor at about 11 torr is given. These calculations do not include the effects of absorbers, but extend the previous results to larger cavity sizes, to lower ambient (pre-shot) cavity pressures, and to higher yields. Wall pressures, temperatures, and densities are reported for five new specific cases, with average cavity pressures ranging from approximately 8 to approximately 90 bars, and peak pressures ranging from 137 to 676 bars. Some typical pressure, temperature, and density profiles in the cavity interiors at various times are reported, in addition to the wall pressures, temperatures, and densities as functions of time for each case. (auth) (USGRDR)

15992 (CEA-BIB-129) PEACEFUL APPLICATIONS OF NUCLEAR EXPLOSIONS. PART 3. MINES, CHEMISTRY, AND GAS AND OIL EXTRACTION. Berton, Micheline (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). Dec. 1968. 118p. (In French). Dep.

A bibliography consisting of 397 articles dealing with the industrial, peaceful, and scientific applications of nuclear explosions is presented which lists mainly U. S. documents relating to the Plowshare program. In addition, Australian, French, German, Italian, and Russian information in this field is covered. The documents are presented in four main categories of nuclear explosion application: chemical (isotope and radioisotope production); extraction of gas and oil; general; and mining. (L.C.L.)

15993 (CEA-R-3594) UNDERGROUND NUCLEAR EXPLOSIONS. STUDY OF THE CAVITY RADIUS. Michaud, Lucien (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes Nucleaires). Nov. 1968. 11p. (In French). Dep.

An underground nuclear explosion creates a cavity due to the expansion of the surrounding medium vaporized by the shot. The cavity radius is related to the energy of explosion and to the overburden pressure of the medium. The introduction of new elements such as the environment of the device (in a deep hole or in a tunnel) and the cohesion of the medium leads to a relationship which determines this radius. The known French and American underground explosions performed in various media, energy and overburden conditions, satisfy this relationship with good precision. (auth)

15994 (NCG-TR-3) PROJECT ZULU II, PHASE I. SINGLE-CHARGE CALIBRATION SERIES. Technical Report No. 3. Johnson, W. W.; Nelson, D. L. (Army Engineer Nuclear Cratering Group, Livermore, Calif. California Univ., Livermore. Lawrence Radiation Lab.). Nov. 1968. 75p. Dep. CFSTI.

Phase I of Project ZULU II was a laboratory-scale crater modeling experimental series consisting of the detonation of forty-two 1-pound C-4 charges in a moist compacted sand. The primary objectives were: to calibrate the medium with respect to its cratering characteristics; to determine the reproducibility of the crater dimensions; to conduct surface motion studies; and to study ejecta and fallback distribution as well as the nature of the displacements occurring in the near vicinity of the zero point and the rupture zone. The cratering curves developed from these experimental series showed an optimum depth of burst (DOB) of 1.5 feet and a rapid decrease of apparent crater dimensions until no crater resulted at a DOB greater than approximately 2.1 feet. The data for ten charges detonated at a nominal DOB of two feet resulted in a fractional standard deviation of 6.4% for crater radius and 20.6% for crater depth, the largest deviations observed for any DOB. The detonation of additional one-half-pound and two-pound C-4 single charges showed that cube-root scaling of apparent crater dimensions was applicable at these yields. The maximum surface ground zero (SGZ) vertical target velocity, V_{SGZ}, was observed to be a function of DOB and conformed to the relationship $V_{SGZ} = 470/DOB^{3.1}$. The resultant velocity, V, of a surface target can be described in terms of DOB and the cosine of the angle between the vertical and a line drawn through the surface target and the shot point, θ_t. This equation can be expressed as: $V = 470\ Cos^{3.6}\ \theta_t/DOB^{3.1}$. The ejecta pellet studies did not successfully record pre- and postshot locations of the material actually ejected from the crater. Analysis of the ejecta pellets displacement data, however, did indicate that the fallback was composed primarily of material which was originally either directly over the zero point or in close proximity to the apparent crater boundary. (auth)

15995 (SC-DR-67-694) SCOOTER REENTRY OPERATION. Burton, R. J. (Sandia Labs., Albuquerque, N. Mex.). Nov. 1968. 57p. Dep. CFSTI.

Scooter, an underground explosion of 500 tons of TNT stacked in a spherical configuration 125 ft below the surface at Yucca Flat, was installed for the purpose of studying crater formation. However, following complete underground emplacement of the explosive system, it was learned that faulty detonators had been installed in the booster block. The choice of reentry method, safety considerations, cost, and actual field operation used to reenter the high explosive sphere and to emplant a new booster block are described in detail. The reentry method consisted of drilling a 14-in. ID hole to the explosive sphere, lowering a 12 in. aluminum sleeve with a neoprene cushion grommet to seal its contact with the TNT, melting a cavity in the TNT using probe heated by internally circulating high temperature hot water, and emplacing a new booster into the melted cavity. Scooter was successfully detonated with the new booster. The drill/melt method used for Scooter reentry was considered the safest and least expensive reentry method. It caused no unexpected problems, was accomplished as scheduled, and is recommended if similar reentry problems should occur in the future. (L.C.L.)

15996 (UCRL-50519) THEORETICAL AND EXPERIMENTAL STUDIES RELATING TO THE PURGING OF RADIOACTIVITY FROM A GAS WELL STIMULATED BY A NUCLEAR EXPLOSION. Higgins, G. H.; Rabb, D. D.; Rodean, H. C. (California Univ., Livermore. Lawrence Radiation Lab.). Dec. 24, 1968. 22p. (PNE-G-29). Dep. CFSTI.

The use of nuclear explosions for natural gas well stimulation requires control or elimination of the radioactivity in the gas produced. Purging the well chimney is one solution to this problem. Theoretical analyses were made to estimate the amount of purging necessary to remove most of the radioactivity. The theoretical results were compared with experimental results from tests on models used to simulate gas well and purging conditions. The results indicated that: in order to minimize the amount of gas flared during purging, the purging rate (flow-rate) should be as high as possible and purging should proceed uninterruptedly; mechanical mixing due to a variety of factors affecting the gas flow can recontaminate areas already cleaned by incoming gases; and, the experimental setup is not perfect and therefore purge tests on nuclear chimneys should be undertaken. (L.C.L.)

15997 (UCRL-50531) WATER QUALITY IN FLOODED NUCLEAR CRATERS. Knox, Joseph B. (California Univ., Livermore. Lawrence Radiation Lab.). Dec. 9, 1968. 23p. Dep. CFSTI.

The ionic concentration of fusion and fission products in water in flooded nuclear craters was studied to determine the safety of using nuclear explosives in the development of water resources. The contaminants considered were ^{144}Ce, ^{137}Cs, ^{106}Ru, ^{90}Sr, and tritium. A hypothetical explosion with a 100 kt total yield was used to estimate the effects of these contaminants on the quality of crater-contained ground water. The cratering process is summarized, and the ion exchange processes which affect the water quality in the crater are described. The migration and quantity of tritium in Sedan Event crater materials are discussed. It is concluded that the concentration of fission-product radioisotopes is near or below the tolerance level for the useful life of a recharge crater, and that tritium is the main source of ground water contamination which would affect the use of nuclear craters for water resources development. (L.C.L.)

15998 (UCRL-71356) PROJECT GASBUGGY OPERATIONAL EXPERIENCES. Kase, K. R.; Greenhouse, N. A.; Silver, W. J.; Norman, G. R. (California Univ., Livermore. Lawrence Radiation Lab.). Jan. 10, 1969. 21p. (CONF-690103-2; PNE-G-28). Dep. CFSTI.

From Health Physics Society Midyear Topical Symposium, Los Angeles, Calif.

Project Gasbuggy, the first nuclear detonation with potential commercial application in the Plowshare Program, is discussed.

The radiological hazards evaluation and safety program is described. The Gasbuggy operation was a success in that the gas flow from the well was substantially increased following detonation. The health physics program associated with Gasbuggy was also successful, in that no significant radiation exposure occurred and radioactivity releases were well-documented and controlled. No radioactive material in excess of established MPC levels was released to the uncontrolled environment. The field experience provided operational experience in a remote location under adverse weather conditions which will aid in determining equipment requirements for future operations. (auth)

15999 (SC-RR-67-860) EXPLOSION WAVE AMPLITUDE STATISTICS FOR A CAUSTIC AT RANGES OF 30 TO 45 MILES. Reed, J. W. (Sandia Labs., Albuquerque, N. Mex.). Feb. 1968. 40p. Dep. CFSTI.

Observations made in 1960 at the Nevada Test Site of HE caustic wave focusing are reported. A collection of 239 microbarograms was obtained of blast waves within about ±10 miles of a calculated caustic from 15 detonations of 1.2-ton HE charges during a 24-hour period. A preliminary analysis of the data indicated that the average atmospheric focus factor was $\bar{F} = 3.15$; the observed maximum was $F_m = 8.31$; and the expected extreme was $F_x = 13.88$. Until a vigorous theoretical treatment of explosion wave focusing becomes available, the data reported herein will allow empirical statistical estimation of caustic hazards. (auth)

16000 (SC-RR-67-870) APPROACH TO AIRBLAST DAMAGE ESTIMATION NEAR CALCULATED CAUSTICS. Reed, J. W. (Sandia Labs., Albuquerque, N. Mex.). Feb. 1968. 16p. Dep. CFSTI.

Procedures are derived for estimating the total damage in the vicinity of a calculated caustic in terms of explosion yield, distance, and population by considering the probability distributions of caustic magnifications and window breakage. (auth)

16001 CAN NUCLEAR RETORTING UNLOCK OIL SHALE? Eng. Mining J., 168: No. 12, 72-5(Dec. 1967).

Project Bronco, a proposed experiment for determining the feasibility of using nuclear explosions in the recovery of oil shale by underground fracturing and in-place retorting, is described. The full experiment would include evaluation of a tentative site of oil shale land in Piceance Creek Basin, Colorado, preparation for the detonation, determination of the best method for in-place retorting, and evaluation of the complete process. Preliminary above ground experiments which have been conducted and which are pertinent to the project are discussed. It is estimated that the Bronco Test would take 5 years to complete. (L.C.L.)

Facilities and Equipment

Refer also to abstracts 16052, 16061, 16188, 16744, 16749, 16792, 16880, and 17308.

16002 (BNWL-CC-1681) ENVIRONMENTAL STRESS CRACKING OF 10 LITER POLYETHYLENE BOTTLES. Kleinpeter, J. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). June 12, 1968. Contract AT(45-1)-1830. 15p. Dep. CFSTI.

The causes of failures in 10 liter polyethylene bottles used to ship and store plutonium nitrate were investigated to determine ways to eliminate the problem. The failures were found to be caused primarily by environmental stress cracking due to excessive pressure in the bottles and can best be eliminated by limiting the maximum total internal pressure to 10 psig. In addition the bottle quality should be specified as to material density and wall thickness. A redesign of the bottle to provide a hemispherical bottom is also recommended. (L.C.L.)

16003 (CEA-CONF-1114) EFFICIENCY OF CARBON-IMPREGNATED TRAPS WITH RESPECT TO FISSION PRODUCT REMOVAL IN A SWIMMING POOL REACTOR ACCIDENT. Dadillon, J. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). [1968]. 33p. (In French). (SM-110/10; CONF-680811-10). Dep.

From Symposium on Operating and Developmental Experience in the Treatment of Airborne Radioactive Wastes, New York.

The efficiency of carbon-impregnated traps for fission product uptake was studied at the CABRI and PIREE reactors. The experimental installations for the simulation of ruptures in the gas loop and the coolant circuit were described. The results indicated that distribution of the iodine in the impregnated carbons shows the existence of several distinct forms of the iodine. The most penetrating is methyl iodide. A significant difference was found between the distribution of ^{131}I and ^{133}I in the carbons. No satisfactory explanation was found for this difference. (J.S.R.)

16004 (CEA-CONF-1120) DEVELOPMENT OF A HIGH-FREQUENCY-HEATED IRRADIATION FURNACE. Briand, A. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). July 23, 1968. 32p. (In French). (Pi(NT)-170-109). Dep.

Irradiation furnaces were developed which permit the realization, under neutron flux, of very high controlled temperatures up to 2000°C. The history of the induction irradiation furnaces is tabulated, and the generators now in use for in-pile heating are given. Experience gained with these furnaces shows that they have a long operational life (3000 hrs), and each irradiation necessitates the combustion of a specific standard. (tr-auth)

16005 (CEA-CONF-1121) MEASURE OF POWER OF FISSILE SAMPLES. CYRANO DEVELOPMENT. Berger, J.; Perrin, J. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). July 18, 1968. 20p. (In French). (Pi(NT)-170-108). Dep.

A device was developed for the irradiation of fuel samples at high linear power. It is equipped with an apparatus for nuclear power measurement and with neutron and γ flux measurements. The device is constructed of a standard furnace equipped with a calorimetric system, a sample gate, the associated fuel and measurement apparatus, and structural elements. Particular modifications of the device (Cyrano, Circe, Polycarpe, and Nadia) and the results obtained by them are described. The Cyrano installation is particularly well adapted to this type of irradiation. (J.S.R.)

16006 (CEA-CONF-1122) EQUIPMENT FOR THE STUDY OF IN-PILE CREEP. Cartier, L. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Aug. 20, 1968. 14p. (In French). (Pi(NT)-170-113). Dep.

A device was developed for the study of in-pile creep. The installation is composed of a standard Chouca-type furnace with its control and feed bay and a creep cell adapted to the measurement system by resonating cavity and introduced inside the furnace. A detailed description is given of the cell and its operation. The temperature control, the tensile stress control, flux and displacement measurements are described. (J.S.R.)

16007 (CEA-R-3619) SOME CRITERIA FOR CHOOSING PRESSES FOR THE COMPACTION OF RADIOACTIVE WASTE. Seyfried, Philippe (Commissariat a l'Energie Atomique, Chusclan (France). Centre de Production de Plutonium de Marcoule). Oct. 1968. 27p. (In French). Dep.

The choice of a press for compacting low-activity radioactive wastes depends on the possibility of recovering the collection and final storage containers. These factors will determine the general design of the machine and the possible limitations to the compacting pressures. The nature of the waste makes it possible to determine the optimum pressure corresponding to the best compression power. It seems that it is possible to distinguish two types of waste according to their behavior on compaction. The cost of the machines is related to the pressure chosen. The price of a machine should, however, be calculated not only from the compaction point of view, but also in the general framework of the treatment of the residues. (auth)

16008 (CEA-R-3629) UNDERWATER CUTTING OF HIGH-ACTIVITY RADIOACTIVE WASTE. Seyfried, Philippe; Lefillatre, Guy; Rodier, Jean; Cochet, Jean-Claude; Cudel, Yves; Brichet, Ludovic (Commissariat a l'Energie Atomique, Chusclan (France). Centre de Production de Plutonium de Marcoule). Nov. 1968. 18p. (In French). Dep.

The method used at Marcoule Center, France, for separating portions of solid radioactive waste according to their activity level is described. These dismantling operations are carried out using a plasma torch or a pneumatic saw in a swimming pool containing de-ionized water. The main advantages of the process are: decrease in the risks of atmospheric pollution, in particular for α contamination; flexibility in adjusting the protection as a function of the β and γ irradiation; ease of handling across a fluid protection; and much lower capital and operating costs than in the case of a reinforced enclosure for the same purpose. (auth)

16009 (EUR-4196) AN IRRADIATION FACILITY FOR IN-PILE MEASUREMENTS OF ELECTRICAL RESISTIVITY AT HIGHER TEMPERATURES UNDER VARIOUS NEUTRON FLUXES FOR OPTIONAL PERIODS. Lang, E.; Schuele, W. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1968. 46p. Dep.

An irradiation facility at Ispra-I reactor for in-pile measurements of electric resistivity of fissile and nonfissile material is described. Encapsulated samples can be irradiated at temperatures between 40 and 1000°C at positions of different neutron fluxes for optional periods. Insertion and extraction of capsules can be performed without shutting down the reactor. Shielding

calculations are included. Neutron flux and distribution in the facility were measured. Operating experience and experiments with brass are reported. (auth)

16010 (ORNL-4372) CONCEPTUAL DESIGN OF A CONTINUOUS THERMAL DIFFUSION PLANT FOR ^{85}Kr ENRICHMENT. Lin, K. H. (Oak Ridge National Lab., Tenn.). Feb. 1969. Contract W-7405-eng-26. 34p. Dep. CFSTI.

The conceptual design of a continuous thermal diffusion plant for enrichment of fission-product krypton with respect to ^{85}Kr is presented. The plant produces enriched material of 45% ^{85}Kr at a rate of 100,000 Ci/year by introducing the feed containing 4% ^{85}Kr through the cascades of thermal diffusion columns. Two alternative cascade arrangements are compared and optimization of the plant is carried out for both designs. The total number of columns required is either 889 or 864 depending upon the design involved. In both designs, the columns are housed in an underground pool that has cooling-water circulation. The preliminary cost estimate indicates the fixed capital cost for the plant to be ~$870,000 and the manufacturing cost exclusive of the feed cost to be $4/Ci. The amount of feed required is estimated at 150,000 Ci/year. (auth)

16011 (ORNL-TM-1675(Rev.1)) PRESTRESSED CONCRETE IN NUCLEAR PRESSURE VESSELS. A Bibliography of Current Literature. Tan, Chen Pang (Franklin Inst. Research Labs., Philadelphia, Pa.). Feb. 1969. Contract W-7405-eng-26. 605p. Dep. CFSTI.

For Oak Ridge National Lab., Tenn.

A bibliography containing 1771 abstracts of published literature on the use of prestressed concrete in nuclear pressure vessels is presented. The abstracts are grouped under the following headings: prestressed concrete reactor vessels, prestressing, concrete properties, vessel design and analysis, construction methods, and engineering design and performance controls. A personal author index is included. This bibliography updates ORNL-TM-1675 dated December 1966 (see NSA 21: 10217). (R.C.K.)

16012 (ORNL-TM-2409) CONCEPTUAL ECONOMIC ANALYSIS OF FLAME REACTOR CONVERSION OF UF_6 TO UO_2. Pratt, R. B. (Oak Ridge National Lab., Tenn.). Feb. 1969. Contract W-7405-eng-26. 28p. Dep. CFSTI.

Costs are estimated for a conceptual industrial-scale process for direct conversion of UF_6 to ceramic grade UO_2 powder in a flame reactor. The design for the industrial-scale process was made from laboratory-scale information currently available. It became obvious early in the analysis that conversions requiring excess fluorine was too costly. Subsequent experiments in which a satisfactory product was made without excess fluorine are the basis of this estimate. Capital, operating, and consumable costs are estimated for plants ranging from 100 to 3000 kG U/day. The resulting costs for flame reactor conversions range from 22.00 to 6.80 $/kG U. These costs are compared with costs for the ammonium-diuranate (ADU) and sol-gel processes. (auth)

16013 (ORO-663) COMMERCIAL IRRADIATION OF SHELLFISH WITH A PORTABLE SHIPBOARD IRRADIATOR. Final Report. Novak, Arthur F. (Louisiana State Univ., Baton Rouge. Dept. of Food Science and Technology). June 30, 1968. Contract AT(40-1)-3413. 48p. Dep. CFSTI.

The commercial feasibility of a shipboard irradiator for the radiation preservation of shrimp using organoleptic, biochemical, and microbiological tests as indices of product quality was determined. The shrimp irradiated both at sea and at dockside were superior to products obtained through commercial channels in previous laboratory experiments in which the products were irradiated on the Louisiana State University campus because the shrimp were out of the water less than 1 hour when they were irradiated aboard the ship and, at most, 5 hours when irradiated on dockside. A crew of food scientists and food engineers supervised the shrimp processing, packaging, and irradiation. As they were caught, the shrimp were separated from the trash fish, washed in sea water, and headed. Half of each catch was packaged and received no irradiation, while the other half was further divided into the three groups to be irradiated at 100, 200, and 300 Krad. After irradiation all samples were stored in the refrigerated hold at 32 to 33°F. Those control samples receiving no radiation (designated control) were stored in the hold upon packaging. The shrimp were transported to the Louisiana State University for further study. On arrival, part of the control was irradiated at 100, 200, and 300 Krad, and were then stored with the other samples. Irradiated shrimp proved superior to nonirradiated shrimp from the same catch when subjected to organoleptic, chemical, and microbiological tests. It can be stated that freshly caught and iced nonirradiated shrimp have a storage life of 14 to 17 days according to the condition and location of catch. By comparison, irradiation of freshly caught shrimp at 200 Krad ±50 Krad followed by storage in ice have a shelf life of 25 to 35 days according to the condition and location of catch. Use of the irradiator on shipboard was extremely simple. The irradiator was operational in adverse weather and did not require any unusual or unorthodox procedures during the irradiation process. The equipment could be operated by persons with little scientific or technical training (although shipboard personnel were thoroughly versed in its construction, safety measures, and radiation hazards). The portable irradiator was placed upon a low-boy trailer and transported to Grand Isle, Louisiana, for dockside testing. Shrimp caught in the Gulf of Mexico were irradiated after being washed, headed, size graded, and packaged. The irradiation dose was 200 Krad. The batch was delivered to Fort Lee, Virginia, for field testing. Enroute, the irradiated samples were kept in crushed ice and the frozen control was kept frozen using dry ice. The shrimp, both irradiated and control, were evaluated in shrimp cocktail 14 days after catching and irradiation by a taste panel and on the average the irradiated shrimp rated slightly higher than the nonirradiated. (F.S.)

16014 (RD/B/N-1142) AN APPARATUS WITH AUTOMATIC DATA HANDLING FOR STUDIES OF REACTIONS BETWEEN GRAPHITE AND FLOWING GASES UNDER IRRADIATION. Dominey, D. A.; Evans, H. E.; Knight, B. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Dec. 1968. 31p. Dep. CFSTI.

An apparatus is described to study the effect of gamma radiation on reactions between graphite labelled with ^{14}C and CO_2 at pressures up to 3 MN/m^2 (400 psi), at temperatures between 400 and 700°K, and at flow rates down to 0.1 std. cm^3/min. The analytical apparatus is fully automatic and data are produced on punched tape. This is processed with a small desk computer for which programs were written. (auth)

16015 (RD/B/N-1195) FINITE ELEMENTS FOR THE REPRESENTATION OF PLANE AND AXISYMMETRIC STRUCTURAL REINFORCEMENT. Campbell, J. S. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Dec. 1968. 16p. Dep. CFSTI.

The theory is derived for finite elements which suitably represent reinforcement in plane and axisymmetric structures. The effects of element self-weight are included in the derivation. The elements developed are used in the C.E.G.B. computer programs FEP and FEX. (auth)

16016 (RN-S-428) PERFORMANCE EVALUATION OF A MODIFIED NERVA TECHNOLOGY PUMP IN LIQUID HYDROGEN AT ZERO NPSP. NERVA PROGRAM. (Aerojet-General Corp., Sacramento, Calif.). Sept. 1967. Contract SNP-1. 55p. Dep. CFSTI.

Cavitation tests were conducted with a modified NERVA technology pump to determine the performance changes resulting from vapor ingestion appearing as a variation of flow rate at the inlet of a fixed-geometry, fixed-speed pump. Performance as a function of net positive suction head (NPSH) and flow rate, including favorable results at zero net positive suction pressure (NPSP), and operational behavior of the positive NPSP pump are discussed. Back-vane performance is discussed in terms of static head coefficients. (auth)

16017 (RN-TM-418) DEVELOPMENT OF THE FLAME-SPRAYED ALUMINUM CONCEPT FOR CONDUCTIVE COOLING OF XE ENGINE-MOUNTED ELECTRICAL CABLES. Sita, E. R. (Aerojet-General Corp., Sacramento, Calif.). Jan. 26, 1967. Contract SNP-1. 35p. Dep. CFSTI.

Methods of convective and conductive cooling of engine-mounted sheathed cables were investigated. It was found that it is possible but not practical to cool sheathed cables in steel conduits with hydrogen gas because of the excessive flow of hydrogen gas required. Organic and metallic materials for heat sinking purposes were investigated. Metal-filled epoxy-base material was found to be unsuitable. It was decided after tests to use flame sprayed aluminum for cable bonding. This method appears to be functionally and mechanically sound. (F.S.)

16018 (TID-4100(Suppl.49)) ENGINEERING MATERIALS LIST. Kelly, Robert C. (ed.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). Feb. 1969. 44p. DTIE Free.

Twenty-five packages of engineering drawings and specifications are presented. Packages of drawings are included on radiation detectors, glove box, motor generator, electrometers, mass spectrometer, phase shifter, liquid metal pump, amplifier, cryostat, oscillator, x-ray tube, photometer, velocity gage, memory extension interface, airborne cloud radar system, solvent washer agitator, miniature centrifugal extractor, Tramex solvent washer, and laser beam monitor. A subject index is included. (R.C.K.)

16019 (TID-4103(Suppl.1)) ENGINEERING MATERIALS LIST. CUMULATIVE INDEX. (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). Feb. 1969. 20p. DTIE Free.

A cumulative subject and corporate author index is presented that includes all packages of engineering materials and specifications that were announced in the Engineering Materials List (TID-4100, Suppl. 43 through 48). A title list of packages arranged in CAPE-number sequence is also included. This index supplements TID-4103, dated June 1968, a cumulative index of engineering materials announced in TID-4100 through TID-4100, Suppl. 42. (R.C.K.)

16020 (UCRL-50561) PROPOSED STRESS ANALYSIS CRITERIA FOR STATICALLY LOADED DEEP-HOLE CASING SYSTEMS. Blake, Alexander (California Univ., Livermore. Lawrence Radiation Lab.). Dec. 2, 1968. 46p. Dep. CFSTI.

Structural loading criteria and stress analysis concepts applicable to the preliminary sizing and developmental testing of components used to case boreholes are reported. Included is a consideration of the strength and stability of stiffened shells, and special attention is given to the effects of manufacturing out-of-roundness and grout rigidity on the modes of failure. The development of more rational factors of safety for deep-hole emplacement hardware is emphasized, and several recommendations are made as to future work in this area. (auth)

16021 CONSIDERATIONS ON METHODS OF DETERMINING THE DEGREE OF TIGHTNESS OF CONTAINERS. Barre, Michel (ENSEM, Brussels). At. Strom, 14: 154-6(Oct. 1968). (In German).

The quality of a case, container, or vessel can be estimated, whatever the volume, from the results of tests carried out during manufacture. Tests of the quality of materials, the condition of joints, and the mechanical resistance of the container are described. (auth)

16022 RI LABORATORY. Ise, Yukimasa (Japan Atomic Energy Research Inst., Tokyo). Kagaku Kogyo, 12: Suppl., No. 15, 134-46(Nov. 1968). (In Japanese).

Radioisotopes enter the body by inhalation, ingestion with foods and drinks, and entry through wounds. The primary objective of ventilation and air conditioning in the RI laboratory is the prevention of the internal radiation exposure by inhalation. The internal exposure continues as long as the radioisotope remains in the body and its radioactivity does not decay. The estimation of internal doses is difficult, and its accuracy is low, therefore, attention must be given to the air contamination especially in cases of alpha-emitting radioisotopes with high ionizing action and beta-emitting radioisotopes with long half life. Experiments with radioisotopes are performed in equipment with reduced pressure that prevents contaminated air from diffusing to other parts of the laboratory. The air is not recirculated in the room and care is taken to move air from places of low contamination to places of high level contamination. The ventilation facilities in the Plutonium Laboratory of the Japan Atomic Energy Research Institute are described. Regarding the control of temperature and humidity, consideration is given to the air flow in the room, the collection efficiency of the filters, oxidation, and spontaneous combustion of plutonium and other materials, and the weather conditions. The automatic control of ventilation in the concrete cave of the hot laboratory, the filtration of exhaust air in the Tokai Laboratory, and the observation of air contamination are described. (NSA of Japan)

16023 IMPROVEMENTS IN OR RELATING TO ULTRASONIC MACHINING APPARATUS. Legge, Percy (to United Kingdom Atomic Energy Authority). British Patent 1,143,789. Feb. 26, 1969. Filed Mar. 9, 1966.

An ultrasonic apparatus is described which is applicable to the machining of hard materials such as ceramics. The apparatus provides an improved form of feed rate control compared with that described in British Patent 987,801, and comprises r abrasive impregnated tool, an ultrasonic transducer and convertor assembly to activate the tool, means for rotating the tool relative to a workpiece, and means to move the tool towards or away from the workpiece, movement of the tool being counterbalanced by means of a piston moveable in a bore with fluid pressure acting to move the piston in a controlled manner. (UK)

16024 IMPROVEMENTS IN AND RELATING TO A MILLING MACHINE. Menissier, Pierre (to Commissariat a l'Energie Atomique). British Patent, 1,144,616. Mar. 5, 1969. Priority date Nov. 28, 1966, France.

A milling machine designed for cutting grooves of predetermined depth along generator-lines of a tubular cylindrical element is described. The element is the metallic cladding which surrounds a fuel rod. The milling machine is used to cut fuel cans by milling in a way to cut the fuel cans into fragments which can be removed without danger of detachment of irradiated fissile materials. (F.S.)

16025 IMPROVEMENTS IN AND RELATING TO A HEAT EXCHANGER. Robin, Marcel (to Commissariat a l'Energie Atomique). British Patent 1,144,297. Mar. 5, 1969. Priority date May 16, 1966, France.

A single-walled heat exchanger adapted to limit welds in contact with both water and sodium is described. Liquid sodium flows through conduits in which are also tubes of smaller section in which water circulates. The tubes for liquid sodium have closed ends but the inner tubes are coupled together. The heat exchanger is fabricated in modules which are connected in parallel to common inlet and outlet collectors. (F.S.)

16026 STUDIES ON THE DESIGN CRITERIA FOR RADIOACTIVE INSTALLATIONS. Fujii, Shoichi; Sekine, Takashi. Kenchiku Kenkyusho Nenpo, No. 41, 377-81(Aug. 1967). (In Japanese).

In the design and construction of atomic energy installations, consideration is given to radiation protection, as well as to proper functioning of the installations. Studies were made in fiscal 1966 on the shielding effect of shielding materials, and high-performance filters. It was found that the reduction of scattered radiation dose rates in a labyrinth can be expressed as $D/D_0 \propto (L/W)^{-2S}$, where D is the amount of scattered radiation, D_0 the incident amount (gamma rays), S the irradiation area, L the distance from the inside surface of walls to the measuring point in a labyrinth, and W the width of the labyrinth, and domestic filters were found to be highly effective. Densities for particle sizes were measured with a high performance filter. (NSA of Japan)

16027 ON THE MEASUREMENT OF COLLECTING EFFICIENCY OF FILTERS FOR SUBMICRON AEROSOL PARTICLES. Sekikawa, Toshio (Science Univ. of Tokyo). Nippon Genshiryoku Gakkaishi, 11: 8-13(Jan. 1969). (In Japanese).

A method of measuring the collecting efficiency of a mechanical filter for submicron aerosol particles was developed based on mobility spectra of ions artificially brought to charge equilibrium by means of the uncharged aerosols. It was found that even a high efficiency filter made of non-woven cloth has an average collecting efficiency of only 50% for submicron aerosol particles with radii of the order of 10^{-6} cm. It was also revealed that the efficiency of such filters was lowest when collecting particles of $4 \sim 5 \times 10^{-6}$ cm radius. (NSA of Japan)

16028 12 INCH FAST GATE VALVE (Engineering Materials). (California Univ., Livermore. Lawrence Radiation Lab.). (CAPE-1838).

39 drawings.

A fast gate valve is described which is used in underground nuclear explosions to protect experimental equipment from high velocity debris or post shot contamination. The closing time is 0.025 sec. The valve is capable of resisting penetrations of particles such as mild steel balls up to 1.0 in. in dia at velocities to 5000 ft/sec. The piston actuator is charged with 6500 psi He. Closing is initiated by detonating 2 high energy firing explosive bolts. Operation is independent of orientation. The valve seat and body are hydrostatically tested to 300 psi. (For details see TID-4100 Suppl. 51). (F.S.)

Heat Transfer and Fluid Flow

Refer also to abstracts 16017, 16192, 17185, 17264, and 17268.

16029 (AD-672837) THERMAL RADIATION PHENOMENA. VOLUME V. RADIATION HYDRODYNAMICS OF HIGH TEMPERATURE AIR. Final Report. Brode, Harold L.; Hillendahl, Richard W.; Landshoff, Rolf K. (Lockheed Missiles and Space Co., Sunnyvale, Calif.). Nov. 1967. Contract DA-49-146-XZ-198. 176p. (LMSC-3-27-67-1(Vol.5); DASA-1917-5). CFSTI.

Radiation hydrodynamics (RH) is introduced and its application to fireballs in the atmosphere is discussed. Basic equations of RH are formulated and attention is given to the radiative transfer problem. Several methods for solving the equations of transfer are mentioned but emphasis is placed on the two stream method with a frequency averaging procedure, which is specifically designed for use with finite zone sizes. A version of the FIREBALL code which utilizes this approach is described. The physics of fireballs is illustrated with the example of a one kiloton detonation at sea level density and without interference from the ground. Some remarks are made on scaling procedures for extending the result to higher yields and altitudes. Estimates are made of the validity of the models. (auth) (USGRDR)

16030 (AEEW-M-793) INTERFERENCE BETWEEN EXPANDING SODIUM VAPOUR BUBBLES. Judd, A. M. (Atomic Energy Establishment, Winfrith (England)). Sept. 1966. 20p. (FRPC/RSWP/P-(66)119). Dep. CFSTI.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

A method is used to calculate the expansion of large numbers of neighboring vapor bubbles in superheated liquid sodium, when the expansion of each individual bubble is retarded by the presence of the other bubbles. A model involving many identical bubbles is used for the main calculations, and this is checked by calculations using a model with two bubbles of different sizes. The accompanying pressure transients are also calculated. (auth)

16031 (AGN-8192(Vol.2)) ALKALI METALS EVALUATION PROGRAM. THERMODYNAMIC AND TRANSPORT PROPERTIES OF RUBIDIUM AND CESIUM. THERMAL CONDUCTIVITY OF THE VAPOR. Achener, P. Y.; Jouthas, J. T. (Aerojet-General Corp., San Ramon, Calif. Nuclear Div.). Oct. 1968. Contract AT(04-3)-368. 73p. Dep. CFSTI.

Results of investigations are reported in which the thermal conductivity of rubidium vapor at temperatures from 824 to 1127°K at pressures from 0.208 to 3.71 atm with superheat ranging from 1 to 40°K, and of cesium vapor at temperatures from 838 to 1073°K at pressures from 0.265 to 2.13 atm with superheat ranging 11 to 52°K was determined. The heat transfer to laminar flow method was used to generate the experimental data. The tests were performed with a specially designed apparatus, fabricated from Nb–1% Zr alloy, which consisted of two boilers, a superheater, a test section (including a thin circular tube in which the measurements were performed), a condenser and a flow measuring device. (auth)

16032 (ANL-7444) INTERACTION OF TWO-DIMENSIONAL, STRATIFIED, TURBULENT AIR–WATER AND STEAM–WATER FLOWS. Linehan, John H. (Argonne National Lab., Ill.). May 1968. Contract W-31-109-eng-38. 103p. Dep. CFSTI.

Thesis. Submitted to Univ. of Wisconsin, Madison.

Analytical models based on an integrated form of the boundary-layer-type equation are developed to describe the interaction of two-dimensional, stratified, turbulent, two-phase fluids. Particular emphasis was placed on the description of flows whereby the gas-phase velocity is at least an order of magnitude larger than the liquid-phase velocity and the gas-phase momentum is the same order of magnitude as the liquid-phase momentum. Under these circumstances, where the momentum transferred from the gas phase to the liquid phase plays a significant role in the behavior of the liquid, the liquid phase occupies a small portion of the flow and is referred to as a film. The models developed were compared to experiments performed in a horizontal test section whose inner dimensions were 6 by $^{21}/_{32}$ in. In the two-component experiments, air flowed over water; in the one-component experiments, steam flowed over water. The film thicknesses in the air-water experiments were measured by the conductance-probes method, and in the steam-water experiments, by the needle-contact-probe method. In turbulent flow, the phase interface is generally characterized by a complex wave structure. For two-component flows, correlations were proposed for the determination of the momentum transferred from the gas phase to the film via turbulent shear stress. In the three-dimensional and roll-wave regimes, the interfacial friction factor was satisfactorily represented by a linear function of the film Reynolds number only. For one-component flows, where the film was subcooled with respect to the temperature of the saturated vapor, the interfacial shear stress was augmented by a term proportional to the product of the average vapor velocity and the condensation rate. The interface shear stress during film condensation was significantly larger than the two-component turbulent shear stress. The wall shear stress in the film was evaluated using the wall-layer-model concept and the von Karman universal velocity profile. The wall-layer model satisfactorily predicted the wall shear stress up to 5000, the highest film Reynolds number encountered in the air-water experiments. Since the film thickness varied in the experiments, the hydrostatic pressure in the film varied in proportion to the axial gradient of film thickness. The hydrostatic pressure variation was an important term in the momentum equations, especially for the low water flowrates. In the development of the model of film condensation, it was assumed that condensation occurred as a result of the subcooling of the film. A model, which emphasized the effect of interfacial wave motion on the transport of heat in the film, was proposed for evaluating the condensing heat-transfer coefficient. This model predicted that the film Stanton number was a constant. The steam-water experiments verified the constancy of the film Stanton number within the range of experimental error; its value was 0.0073. (auth)

16033 (CEA-R-3465) MEASUREMENT OF THE LOCAL VOID FRACTION IN TWO-PHASE AIR–WATER FLOW WITH A HOT-FILM ANEMOMETER. Delhaye, Jean-Marc (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Oct. 1968. 66p. Dep.

Experimental knowledge of local void fractions is basic for the derivation of the constitutive equations of two-phase flow. Measurements of local void fraction based on the use of a constant temperature hot-film anemometer associated with a multichannel analyzer are reported. After determining the void fraction, profile along a diameter of a vertical pipe (40 mm ID), in which air and water flow upwards, the void fraction averaged over the diameter is compared with the average value measured directly by a γ-ray method. Two runs were made in bubble flow and a third in slug flow. The results of the two methods were comparable with especially good agreement for bubble flow. The void fraction averaged over the cross-section was also calculated from the different profiles and compared favorably with the experimental results of R. Roumy. For bubble flow, the experimental results verified the theory of S. G. Bankoff about the shape of the void fraction profiles. (auth)

16034 (NYO-3679-7) HEAT TRANSFER AND HYDRAULICS: THE EFFECTS OF SUBCOOLED VOIDS. Seventh Quarterly Report, October–December 1968. Staub, F. W.; Walmet, G. E.; Niemi, R. O. (General Electric Co., Schenectady, N. Y. Research and Development Center). Dec. 1968. Contract AT-(30-1)-3679. 45p. Dep. CFSTI.

Progress on an analytical and experimental program directed toward the determination of the void distribution, location of the initiation of net vapor generation, pressure drop and heat transfer coefficients in subcooled boiling water is reported. Required changes in the instrumentation and the test loop for employing Refrigerant 22 were completed. Hydrostatic pressure tests validated operation at 500 psi. Pressure, temperature and initial void calibration checks were completed. The data reduction program was converted to time sharing and debugging is complete. Data taken with reactivity and pH control agents showed lower values of mean drift velocity in the bubbly flow regime corresponding to the higher values of the distribution parameter and agreeing with the lack of bubble agglomeration observed with additives. Data for 19 test runs in the high-pressure water test loop were reduced. Inconsistencies remaining are being resolved. When the remaining runs are finished, experimental results will be compared with correlations previously developed. (F.S.)

16035 MEASUREMENTS OF THE RESTFILM THICKNESS WITH THE SINGLE BUBBLE EJECTION OF FLUID SODIUM IN A TUBE. Spiller, K.-H.; Perschke, D.; Grass, G. (EURATOM, Ispra, Italy). Atomkernenergie, 14: 113-17(Mar.-Apr. 1969). (In German).

Sodium was subjected to boiling in a vertical tube at 7 mm inner diameter and 1000 mm length. After superheating of the liquid a type of boiling occurs that is characterized by single bubble ejection. In this process a restfilm remains attached to the inner wall of the tube. The thickness of this film and its diminution with time by evaporation were evaluated using an electrical resistance method. In some cases a running away of the film was observed too. (auth)

16036 MATHEMATIC CALCULATION FOR INSTABILITY IN TWO-PHASE FLOW. Mayinger, F.; Kastner, W. (MAN, Nuremberg). Chem.-Ing.-Tech., 40: 1185-92(Dec. 1968). (In German).

Measurements in heated boiling water flow have shown that, with heat flow densities under certain thermodynamic and hydrodynamic conditions, two-phase flow is unstable, i.e., that aperiodic or periodic pressure- and flow-changes occur. An attempt was made to explain these experimental observations theoretically by means of a simple set of equations. The calculation involves the use of the continuity equation, the momentum equation, and an energy balance, and takes into consideration the characteristic features of boiling-water flow, the two-phase friction and lead rate of the steam bubbles. The streaming and vibration influences of essential constructional components of a boiling water circulation, e.g., of the circulating pump, of the restrictors, and of the spaces filled with compressible vapor, are considered in the calculation. (auth)

Isotope Technology

Refer also to abstracts 15964, 16010, 16127, 16476, and 16853.

1603? (AD-673108) PLUTONIUM BERYLLIUM NEUTRON SOURCE AS A SECONDARY CALIBRATION STANDARD. Devan-

ney, John A. (Ballistic Research Labs., Aberdeen Proving Ground, Md.). June 1968. 36p. (BRL-1401). CFSTI.

Plutonium-beryllium (Pu-Be) neutron sources are calibrated with respect to total output, using a manganese sulfate bath. When such sources are used as a point isotropic, secondary standard, inaccuracies occur due to the neutron output not being isotropic, the neutron output increases with time due to the buildup of americium-241, resulting from the impurity of plutonium-241, the output spectrum is continuous from approximately 0.5 MeV to 10 MeV, and gamma rays exceed the number of neutrons emitted from the source. The angular distribution of the neutron output of an 80 gram (4.81 Ci) plutonium-beryllium neutron source shows that the increase in neutron output, due to the buildup of americium-241 is 5.3 percent for a period of 43 months, the neutron and gamma ray spectral distribution and intensity, a neutron to gamma ray intensity ratio of 0.61 : 1, and a neutron to gamma ray dose (first collision-rads tissue) ratio of 9.36 : 1 and that a correction factor of 6.6 percent is required when the source is used as a point isotropic source of neutrons. (auth) (USGRDR)

16038 (AD-673180) ISOTOPES IN THE USSR. COLLECTION OF ARTICLES ON THE EXCHANGE OF SCIENTIFIC AND PRODUCTION EXPERIENCE. (SELECTED ARTICLES). Meshcherin, V. T.; Shtan, A. S.; Misozhnikov, V. V.; Sulkin, A. G.; Sakharov, E. V. Translated from Izotopy SSSR, No. 1, 5-14; 18-28; 42-6(1965). 82p. (FTD-MT-66-152). CFSTI.

Articles are presented on radioisotopes in forging-stamping production; certain questions of the technico-economic analysis and economic efficiency of the use of radiation technology; experiment in the use of radioisotope methods and instruments at the Moscow Carburetor Plant; methods and equipment of radioisotope defectoscopy; a special operation regarding assembly and adjustment of radiation technology by the all-union organization (V/O) IZOTOP; and innovations in radioisotope technology. (USGRDR)

16039 (KFK-859) SEPARATION OF THE URANIUM ISOTOPES: A COMPARISON OF THE PROCEDURES UNDER DISCUSSION TODAY. Becker, E. W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Kernverfahrenstechnik). Oct. 1968. 24p. (In German). Dep.

The general construction of uranium isotope separation installations is described. The concepts of value function and separative work used for the characterization of their efficiency were explained. The technical details of the gaseous diffusion method, the gas centrifuge method, and the separating nozzle method, as far as they are known from the open literature, are reported. The economic aspects of the three methods are compared. (J.S.R.)

16040 (KURRI-TR-7) STUDIES OF THE UTILIZATION OF RADIOISOTOPIC TRACERS IN THE FIELD OF SANITARY ENGINEERING. Tsutsui, Tenso (comp.) (Kyoto Univ. (Japan). Research Reactor Inst.). [1965]. 11p. (In Japanese). Dep.

A summary of four papers presented at a symposium sponsored by the Kyoto University Reactor Research Institute held at Kyoto University on January 26, 1965, is presented. Kawashima (Osaka Institute of Technology) surveyed the recent literature on the application of radioisotopes as tracers for studies of water supply and to sewage problems. Inoue (Tokyo University) discussed the use of radioisotopes both as radiation sources for treating sewage and as a tracer in the field of sanitary engineering. Activation analysis was mentioned as a promising technique for trace metal analysis which often presents difficulties. Kamiyama (Hokkaido University) listed the problems for which radioisotopes can be utilized: determination of the filtering mechanism of sewage filter beds; study of biochemical and organic decomposition processes; measurement of the association and decomposition rates of organic compounds, and examination of adsorption, sorption, retention, and absorption processes by activated sludge. Sago (Tokyo University) discussed the environmental contamination by a reactor. In view of the lack of data, he proposed that radioisotopes would be useful to determine the degree of environmental contamination that could result from the construction and operation of a reactor. (TTT)

16041 (SC-CR-68-3470) REPORT OF STUDIES WITH PARTICLES IMPACTED ON COPPER PLATES FROM THE ABLATION OF SIX $^{238}PuO_2$ FUEL PARTICLES UNDER CONDITIONS SIMULATING ATMOSPHERIC RE-ENTRY. Holland, W. D. (Tracerlab, Richmond, Calif.). Jan. 1969. Contract ASB 48-6048. 210p. Dep. CFSTI.

For Sandia Labs., Albuquerque, N. Mex.

With six samples composed of particles that contained ^{238}Pu, particle studies were performed by autoradiography and electronic alpha counting. The particles, which were collected on polyvinylchloride (PVC) coated copper plates, were collected during the ablation of individual SNAP fuel particles in a 40 kW hyperthermal arc tunnel under conditions simulating atmospheric re-entry. Three re-entry conditions were simulated. Size distribution histograms of equivalent $^{238}PuO_2$ particle diameters greater than 0.2 μ were obtained for each sample. These equivalent $^{238}PuO_2$ particle diameters range from 0.2 to 13.5 μ. Typical radioactive particles were taken from each sample. Results of radiochemical analysis of all particles collected on five of the impactors and of individual particle measurements obtained by the hollow-star and electronic-counting techniques were used to tabulate the mass distributions from zero to the size of the largest particle found. The results of radiochemical analysis indicate that about 95% of the mass of PuO_2 collected is in particles with equivalent $^{239}PuO_2$ diameters < ~0.1 μ. Duplicate tests performed with samples collected under two re-entry conditions showed outstanding precision in mass distributions, indicating that there were no experimental errors. (auth)

16042 (SC-DR-68-890) SNAP-27 GLFC/FCA AIR DROP TESTS. Baker, F. L. (Sandia Labs., Albuquerque, N. Mex.). Jan. 1969. 25p. Dep. CFSTI.

Five dummy SNAP-27 Graphite LM Fuel Casks (GLFC's) and one engineering evaluation GLFC/Fuel Capsule Assembly (FCA) were drop tested at the Tonopah Test Range (TTR) to obtain an assessment of capsule damage in a probable impact situation in which the capsule was contained in the GLFC. Photographs of the GLFC/FCA at the impact site, photographs of post impact assembly components, and pertinent data are presented. (auth)

16043 CALUTRON ION SOURCE WITH MAGNETIC FIELD INDUCING COIL WITHIN ARC CHAMBER. Lee, J. V.; Love, L. O. (to United States Atomic Energy Commission). U. S. Patent 3,432,709. Mar. 11, 1969.

An ion source for a calutron is provided with an electrically biased current loop within its arc chamber. Dc current is passed through the loop in a direction so as to create a magnetic field directed toward the ion exit slit of the ion source. The magnetic field promotes the migration of ions formed in the arc chamber through the exit slit, thereby effecting a substantial increase in the operating efficiency of the ion source while operating at about one half the normal vapor feed rate. (AEC)

16044 USA STANDARD N5.10-1968: CLASSIFICATION OF SEALED RADIOACTIVE SOURCES. USA Standards Inst. Committee N 5.4, August 29, 1967. New York, American Institute of Chemical Engineers, 1968. 14p.

A standard, to promote uniformity of purpose and to assure containment of the radioactive material within the sealed source is described. The standard establishes classifications for sealed sources according to the use. The classification is based on radiotoxicity, Curie content, and performance requirements. Design standards are left to the judgment of the supplier and user. (F.S.)

16045 RADIOISOTOPE AND THERMOELECTRIC CONVERSION GENERATORS. Freund, J. Energ. Nucl. (Paris), 10: 430-9(Nov. 1968). (In French).

A general introduction to radioisotopic generators is presented. Criteria used for the selection of radioisotopic fuels are summarized. Three groups of thermoelectric materials are discussed. The problems which arise in the construction of an isotopic generator are reviewed. (auth)

16046 APPROXIMATE ESTIMATION OF THE THERMODIFFUSIONAL CONSTANT VALUE IN ISOTOPIC LIQUID MIXTURES. Rabinovich, G. D. Inzh.-Fiz. Zh., 15: 1014-18(Dec. 1968). (In Russian).

An attempt is made to generalize the experimental data available on the value of thermodiffusional constant for isotopes in a liquid phase. The experimental points tend to concentrate near the straight line $\alpha_K = 5.4\ M_1 - M_2\ M_1 + M_2$ (1). Based on the theoretical works by Drinamer and Doggerty carried out on irreversible thermodynamics, the connection between the numerical coefficient in the above expression and evaporation heat is established for non-polar fluids. Methods are suggested for calculating the relative mass difference $(M_1 - M_2)\ (M_1 + M_2)$ for cases when the divided compound contains isotopes of various masses, and it is shown that by applying the above methods, one can satisfactorily correlate the data on the value of the thermodiffusional constant for the melted metals with relation (1). (auth)

16047 GAS DIFFUSION INSTALLATIONS IN THE USA FOR THE PREPARATION OF ENRICHED URANIUM. Wuensche, Ralf (Preussische Elektrizitaets-AG, Hanover). At. Strom, 14: 137-41(Oct. 1968). (In German).

The data published in a report by the American Atomic Energy Commission on its gas diffusion installations are summarized. Comprehensive data are given for the first time on the efficiency,

the mode of operation and the economics of the installations. Attention is drawn to the possibilities of expanding the installations, and to the estimated costs for new enrichment installations based on the gas diffusion principle. (auth)

16048 METHOD OF MAKING A ^{90}Sr RADIATION SOURCE. Case, F. N.; Mackey, T. S.; McFarland, C. E. (to United States Atomic Energy Commission). U. S. Patent 3,431,328. Mar. 4, 1969.

A beta source comprising strontium-90 microspheres embedded in an aluminum matrix and encased in stainless steel, is described. The source is fabricated from a mixture of strontium-90 silicate microspheres and molten aluminum in a stainless steel container. The molten aluminum is forced into the voids between the microspheres thereby cooling the resulting mass. (AEC)

16049 ISOTOPES AND RADIATION TECHNOLOGY. Volume 6, Number 3. Baker, P. S.; Lafferty, Robert H. Jr.; Carden, Joan E.; Gerrard, Martha; Greene, R. E.; McKinney, F. E.; Miller, F. J. (eds.). One of the Four Technical Progress Reviews Published for the Division of Technical Information, USAEC. Oak Ridge, Tenn., Oak Ridge National Lab., Spring 1969. 124p. GPO $0.70.

For abstracts of individual sections see: 15893, 15969, 16050, 16051, 16105, and 16106.

16050 USE OF RADIOISOTOPES IN THE MEASUREMENT OF WOOL GROWTH. Downes, A. M.; Clarke, W. H.; Dagg, T. C. (Commonwealth Scientific and Industrial Research Organization, Prospect, Australia). Isotop. Radiat. Technol., 6: 273-9(Spring 1969).

A method for measuring the rate of growth in length of individual wool fibers is described. Radioisotope-labeled amino acids are injected into the animal, and autoradiograms are made of the fibers at various intervals of time. (auth)

16051 FIRST ^{242}Cm ISOTOPE BATTERY IN EUROPE. Isotop. Radiat. Technol., 6: 321-2(Spring 1969).

A description is given of the design and operation of a ^{242}Cm-powered battery which began operating July 5, 1968, at the European Transuranium Institute. (L.C.L.)

16052 IRRADIATION DEVICE FOR PROVIDING A CONSTANT DOSE RATE. Kimble, H. E. (to United States Atomic Energy Commission). U. S. Patent 3,432,665. Mar. 11, 1969.

A constant level dose rate from a radiation source is provided over a period of time which may correspond to a duration substantially greater than the half-life of the source. The source size is increased by as much as several factors over the size of a source required for the desired dose rate. A sufficiently large portion of this bigger source is then exposed at a window in a housing containing radiation moderating material to provide the desired dose rate and, as the dose rate decreases due to natural decay, a greater portion of the source is moved to the window to provide and maintain the constant level dose rate. (AEC)

16053 DOSE BUILDUP FACTOR OF A ^{60}Co CYLINDRICAL SOURCE WITH A SHELL SHAPED SHIELD. Kanemori, Yoshihiko (Mitsui Shipbuilding and Engineering Co., Ltd., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 6: 103-4(Feb. 1969).

The saturation dose buildup factor was experimentally determined in the radial direction at the half-height of a cylindrical ^{60}Co source. An air gap located between the source and shell of the iron shield was found to lower the dose buildup. (F.S.)

Materials Testing

Refer also to abstracts 16006, 16042, 16482, 16485, and 16501.

16054 (BNWL-953) BROADBAND ELECTROMAGNETIC TESTING METHODS. PART IV. MULTIPARAMETER TEST PRINCIPLES. Libby, H. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 1, 1969. Contract AT(45-1)-1830. 60p. Dep. CFSTI.

Multiparameter or multivariable eddy current principles and techniques are described whose application gives more information about test specimens than can be obtained using conventional eddy current nondestructive test methods. The test coil assembly is driven by multifrequency or pulsed currents. Its output, having been modulated by the test parameters or variables is amplified, applied to spectrum filters and demodulated. The demodulated signal components are then recombined in selected linear combinations to give the read-out of individual test parameters or separate output channels. The principles are explained by a generalization of the single frequency phase discrimination technique, by an algebraic method and by a geometrical interpretation involving vector spaces. Selected test results are given for two and four frequency test systems. A two frequency tubing cross-section display device is described which displays fabricated defects on the outer and inner walls of a tube in their relative locations. (auth)

16055 (BNWL-SA-2275) NONDESTRUCTIVE TESTING OF SMALL DIAMETER, STAINLESS STEEL FUEL CLAD TUBING. Ryden, J. Jr. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [1969]. Contract AT(45-1)-1830. 20p. (CONF-690311-1). Dep. CFSTI.

From National Spring Conference of the American Society for Nondestructive Testing, Los Angeles, Calif.

Techniques used to inspect FFTF fuel cladding for defects are discussed. Descriptions are given of the three different testers used to inspect this tubing. They are a sinusoidal eddy current tester, an ultrasonic pulse-echo tester, and an ultrasonic tester that uses a send-receive system of transducers. Micrographs, strip charts, and statistical data obtained from the inspection of 20,000 feet of tubing are presented. (auth)

16056 (CEA-CONF-1141) USE OF THE TECHNIQUE OF FOUCAULT CURRENTS FOR THE NONDESTRUCTIVE TESTING OF FUEL ELEMENT TUBES FOR FAST REACTORS. Dufayet, J. P. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). [nd]. 30p. (In French). (CONF-681004-4). Dep.

From 28th National Fall Conference of the American Society for Nondestructive Testing, Detroit, Mich.

Nondestructive testing by Foucault currents was studied on small diameter stainless steel tubes. The installation designed for these tubes consists of exploring coils of the encircling type. The motion of the tube is parallel to the axis of the coil which simplifies the mechanical problems of decladding. The installation used for the testing is described and some characteristic faults detected are presented. This installation contains two Foucault current devices whose performances and controls were chosen so as to complete the data available on defects. The study of this installation led to the development of an automatic laboratory device for subjecting the tubes to defectograph tests, to a test with the high frequency device, and a continuous measurement of the diameter. A control unit is proposed which combines several devices on a single bank with a fast processing procedure for diverse data. (tr-auth)

16057 (NVO-38-16) EVALUATION OF HALLIBURTON "TUF" CEMENT FOR USE AS A CAVITY LINER MATERIAL. Vesper, Russell L. (Fenix and Scisson, Inc., Las Vegas, Nev.). Sept. 1968. Contract AT(26-1)-38. 55p. Dep. CFSTI.

Test results indicated that "Tuf" cement concrete is a suitable structural material for use in the relatively shallow cavity liners at the Nevada Test Site. Experience gained by use of this material at the Nevada Test Site can be used for evaluation of the material for cavity liners at the Supplemental Test Sites. (auth)

16058 (Y-DA-2855) ACOUSTIC EMISSION FOR NONDESTRUCTIVE TESTING AND CERTIFICATION. Moyer, M. W. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Feb. 20, 1969. Contract W-7405-eng-26. 10p. (CONF-690205-1). Dep. CFSTI.

From Acoustic Emission Working Group Conference, New Orleans, La.

The equipment employed in using acoustic emission testing as a tool for materials testing and certification is described. Tests performed on 8 aluminum alloys, an aluminum cantilever beam, and stress corrosion of uranium alloys are discussed. Future plans for the examination of welds and stress corrosion are given. (F.S.)

16059 DEVICE FOR PRODUCING STEREOSCOPIC RADIOGRAPHS. Martina, Eugene F. (to Secretary of the Air Force). U. S. Patent 3,422,264. Jan. 14, 1969. Filed Jan. 14, 1966.

The object for which a radiograph is desired is irradiated with neutrons from a neutron source which results in an isotropic emission of gamma rays from the object. A pair of pin hole cameras are located on the same side of the object as the neutron source to receive the returned gamma rays. Each of the pin hole cameras has a phosphorescent screen which produces an image of the object. The image on each of the phosphorescent screens is imaged onto the input of an image intensifier tube with the outputs of the image intensifier tubes being applied to the inputs of television camera tubes. The outputs of the camera tubes are supplied to a pair of display tubes with the outputs of the display tubes being combined on a display screen. (Offic. Gaz.)

Radioactive Material Handling

Refer also to abstracts 15965, 15973, 16002, 16007, 16008, 16022, and 16281.

16060 (AERE-R-5900) RADIOACTIVE WASTE CONTROL AT THE UNITED KINGDOM ATOMIC RESEARCH ESTABLISHMENT, HARWELL. Burns, R. H.; Clare, G. W.; Clarke, J. H. (Atomic Energy Research Establishment, Harwell (England)). Sept. 1968. 49p. Dep. CFSTI. UK 12s.

The following topics are reviewed: liquid effluents (drainage system, low-level treatment plant, discharge to River Thames, medium- and high-level effluent treatment plant, ion exchange, evaporation, sludge handling), and solid radioactive wastes (storage, burial, sea dumping, sorting and volume reduction). (UK)

16061 (CEA-CONF-1113) SEPARATION OF PARTICLES FROM GAS OF COMBUSTION IN AN INCINERATOR FOR RADIOACTIVE RESIDUES. Sutra-Fourcade, Y.; Caire, B.; Gallissian, F. (Commissariat a l'Energie Atomique, Chusclan (France). Centre de Production de Plutonium de Marcoule). [1968]. 29p. (In French). (CONF-680811-11).

From Symposium on Operating and Developmental Experience in the Treatment of Airborne Radioactive Wastes, New York.

In the evaluation of an incinerator, one of the most important problems is the selection of the apparatus for the purification of the gases emitted by the combustion of the radioactive residues. The factors to be considered in this selection are the temperature of the gas, corrosion risks, combustion and post-combustion, control of the air intake, nature of the construction materials, price of the materials, and nature of the residues to be incinerated. Each of these factors is critically analyzed. An installation for the extraction of particles from combustion gases developed at Marcoule is described. The purification system consists of a cyclone, a spark-arrestor filter, sleeve filters, and absolute filter prefilters with a total stopping power above 99.99%. (J.S.R.)

16062 (GA-9077) APPLICATION OF PHOTOINDUCED REACTIONS TO NUCLEAR MATERIALS SAFEGUARDS PROBLEMS. Quarterly Progress Report for the Period July 1, 1968–September 30, 1968. Beyster, J. R.; Bramblett, R. L.; Jupiter, C. P.; Gozani, T.; Ginaven, R. O.; Kull, L. A.; Rundquist, D. E. (Gulf General Atomic, Inc., San Diego, Calif.). Nov. 8, 1968. Contract AT(04-3)-167. 46p. Dep. CFSTI.

The gamma spectra of ^{232}Th, ^{235}U, ^{238}U, and ^{239}Pu were measured, as were the gamma spectra of photofission products of ^{235}U, ^{238}U, and ^{239}Pu at selected times after irradiation. Prompt and delayed neutron yields from photofission of ^{235}U, ^{238}U, and ^{239}Pu at endpoint energies between 5.5 and 9 MeV were investigated. Construction of a neutron counter using eight BF_3 detectors was begun, and pyrex vessels were fabricated for the high-efficiency gamma detectors. Electronics instrumentation for the assay system was tested and evaluated, and field measurements on the 270° magnet system were almost completed. The precision of assays based on an electron accelerator assay system was analyzed. Components of a transportable assay system were evaluated. (D.C.W.)

16063 (IN-1257) EQUIPMENT AND TECHNIQUES FOR SEALING AMPOULES CONTAINING IRRADIATED ^{235}U SOLUTIONS. Trammell, D. R.; Wade, M. A.; Fortsch, E. M.; Brinkley, H. G.; Huff, G. A. (Idaho Nuclear Corp., Idaho Falls). Jan. 1969. Contract AT(10-1)-1230. 10p. Dep. CFSTI.

Evaporation through poorly made seals is suggested as the cause of irradiated ^{235}U solutions concentrating in ampoules during storage. Recently developed improved ampoule sealing techniques and equipment are described which overcome this problem. (auth)

16064 (KURRI-TR-9) RESEARCH ON THE DISPOSAL OF GASEOUS, LIQUID, AND SOLID RADIOACTIVE WASTES. Special Research Committee Report, Meeting held January 25, 1965. Tsutsui, Tenson (comp.) (Kyoto Univ. (Japan). Research Reactor Inst.). [1965]. 26p. (In Japanese and English). Dep.

Three papers on radioactive waste disposal studies conducted at Japanese nuclear facilities are presented. A separate abstract was prepared for each. (L.C.L.)

For abstracts of individual papers see: 16065–16067.

16065 (KURRI-TR-9, pp 3-5) RADIOACTIVE WASTE DISPOSAL. Iwai, Shigehisa (Kyoto Univ. (Japan). [Research Reactor Inst.]). (In Japanese).

Gaseous radioactive waste products generated at a reactor site include the rare gases ^{85}Kr and ^{133}Xe, the halogen ^{131}I, volatile compounds of Po and Ru; ^{41}Ar and compounds containing ^{14}C produced by activation must also be considered. The methods used are reviewed, tabulating the best obtainable decontamination factors. The annual use of unsealed radioisotopic source in Japan amounts to about 100 Ci. About 80% of these materials have a half-life of 30 days or less; the remainder requires special disposal methods. The total amount is small compared to those used in the United States and the disposal does not present a serious problem as yet but if the nuclear energy program continues its present rate of development, the disposal of waste effluents from radioactive fuel reprocessing plants must be seriously studied to anticipate the load. The methods used for concentrating and disposing wastes are reviewed. (TTT)

16066 (KURRI-TR-9, pp 6-10) DISPOSAL OF RADIOACTIVE WASTES AT THE JAPAN ATOMIC ENERGY RESEARCH INSTITUTE. Sugimoto, Sen-ichi (Japan Atomic Energy Research Inst., Tokyo). (In Japanese).

The radioactive waste disposal program at the Japan Atomic Energy Research Institute must take into account the waste materials which keep accumulating at five reactor sites and several research facilities. The wastes are either removed to remote locations or stored. Recently, JAERI has been assigned the task of also removing the radioactive wastes resulting from activities of the Radioactive Isotopes Society. The amounts of solid and liquid wastes handled during the period from 1958 tc 1964 are tabulated. The very low-level liquid wastes have been diluted and then released. The low-level liquid wastes have been concentrated, then solidified and stored. This method of disposal was found effective but expensive. The solid waste materials usually possess a low activity; they are stored in cartons. Whenever possible, combustible materials are burned to reduce the volume before placing the remainder in drums. Burning was found to result in a 1:70 reduction of the volume, compared to 1:5 by pressure packing; however, it is about four times more expensive. High-level waste materials are placed in casks and disposed by burying them. (TTT)

16067 (KURRI-TR-9, pp 11-24) RADIOACTIVE WASTE DISPOSAL AT THE LABORATORY FOR RADIATION MEDICINE. Ito, Fumio. (In Japanese).

The Radioisotopes Laboratories, medical center, waste disposal facility and an α facility are provided with air filtration systems using glass filters and a high-capacity filter; at special locations capillary and oil filters are used. Recent experience revealed that contamination of the filters is slight but they lose their efficiency very fast. For disposal purposes, the filters are considered as nonburnable solids. The ion exchange resins used for treating liquid radioactive waste effluents are also handled as solid waste materials. Carcasses containing radioisotopes are stored temporarily in deep-freeze units, packaged in polyethylene bags, awaiting ultimate disposal. The liquid radioactive materials are handled as high-level streams which are stored and as low-level flowing effluents. Persons working with radioisotopes are provided with a can for high-level waste which is subsequently disposed at special disposal areas. Medium-level liquid waste is concentrated by an automatic evaporation unit, disposing the concentrate in the usual manner. The low-level liquid waste system is based on that used at Harwell; it is capable to remove more than 99% of the radioisotopes in waste with activities of the order of 10^{-6} μCi/ml. The decontamination achieved is affected by the filtration and ion-exchange technique employed. A special system was developed for the treatment of α-active materials. (TTT)

16068 (ORNL-4275, pp 1-3) PROCESS DEMONSTRATION AND ^{233}U DISTRIBUTION. Parrott, J. R.

The uranium-233 receipts and shipments of the group handling this material at ORNL are compared during 1960 to 1966. Quantity, form, % ^{233}U, and ^{232}U content are tabulated for the inventory. (J.C.W.)

16069 (ORNL-4275, pp 4-14) THORIUM–URANIUM RECYCLE FACILITY. Irvine, A. R.

The progress on TURF construction is briefly described. Design of sol-gel process equipment is described and construction progress reported. Conceptual designs for the fueled-graphite refabrication equipment have been completed and a working flow diagram has been developed. (J.C.W.)

16070 CRITICALITY CONTROL IN AN IRRADIATED FUEL REPROCESSING PLANT. Fruchard, Y. Energ. Nucl. (Paris), 10: 445-55(Nov. 1968). (In French).

Results of experiments and calculations showing the action of various parameters e.g., moderation and specific gravity, on critical masses and critical geometries are described. The methods of criticality control—concentration control, mass control, dimensional control, poisoning—are analyzed and their advantages and disadvantages are discussed. These methods are used

in the chemical processing plant of the Marcoule Center. The use of geometry suitable to this kind of plant is summarized. Three incidents that occurred in the plant, illustrate the possible failures of the nuclear safety practices. (auth)

16071 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR HANDLING SUBMERGED ARTICLES. Lindstaedt, H. K. W. (to Fairey Engineering Ltd.). British Patent 1,143,216. Feb. 19, 1969. Filed Jan. 29, 1965.

Apparatus is described which is particularly suitable for handling fragile articles and articles which are liable to small variations in shape. An application is for handling submerged fuel elements after removal from a nuclear reactor. The apparatus comprises one or more hydraulic suction pads having recessed suction surfaces, the recesses being connected to a source of hydraulic suction. Where the articles are of cylindrical form the suction pads may have surrounding flexible lips arranged to make close contact over part of the cylindrical surface, and associated with a rigid backing member. The pads are mounted on a support, and the apparatus includes means for moving the support in at least one direction, and preferably simultaneously or consecutively in at least two directions. The apparatus may also be used as part of a machine for dismantling nuclear reactor fuel assemblies of the cluster type. (UK)

16072 DIE VOELKERRECHTLICHE ZULAESSIGKEIT DER VERSENKUNG RADIOAKTIVER ABFAELLE IN DAS MEER. (The Admissibility Under International Law of Sinking Radioactive Waste in the Sea). Erler, G.; Schubert, K.; Boehnecke, G. (eds.). Berichte der Studiengesellschaft zur Foerderung der Kernenergieverwertung in Schiffbau und Schiffahrt e. V., Hamburg, No. 14. Muenchen, Verlag Karl Thiemig KG, 1968. 132p. DM 16.80. (NP–17730).

The legal questions connected with the disposal of radioactive wastes in the sea are critically reviewed and analyzed. The pertinent international law with respect to the high seas and to coastal seas and its probable interpretations are cited. Possible guidelines for future regulations are given. The liability arising from injury from the waste disposal in the sea is also considered. (J.S.R.)

16073 TRANSPORT CONTAINER FOR IRRADIATED FUEL ELEMENTS. Colhoun, Ch. (Transnuklear GmbH, Frankfurt am Main). Atomwirt., Atomtech., 14: 76-8(Feb. 1969). (In German).

An economic evaluation of transport containers for irradiated fuel elements showed that a container which would be suitable for the transport of radioactive materials other than fuel elements would be advantageous. The MTR and the TN-2 containers, for transport of fuel elements from research and power reactors, are described. (J.S.R.)

Vacuum Engineering

16074 APPLICATION OF AN ION–ELECTRON CONVERTER WITH COUNTING DEVICE AS AN ULTRA-HIGH VACUUM GAUGE. Kirchner, Fritz (Univ., Cologne); Weil, Frithjof. Vakuum-Tech., 17: 217-23(Nov. 1968). (In German).

A Bayard–Alpert-type ionization gage with an ion-electron converter and counting device attached is described. The measuring range is 1×10^{-4} torr to 5×10^{-14} torr divided into two subranges: range I (1×10^{-4} torr to 1×10^{-9} torr) only on the B-A gage, in range II (1×10^{-9} torr to 5×10^{-14} torr) the ion-electron converted attached to the gage. In this case the B-A ionization gage serves as the ion source. Pressures less than 10^{-12} torr can be measured by means of this principle if a lanthanum boride cathode is used in the ionization gage. (auth)

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 16062, 16357, 17103, and 17107.

16075 (AECL-3144) PORTABLE CONTAMINATION METER. Jones, A. R. (Atomic Energy of Canada, Ltd., Chalk River (Ontario)). Jan. 1969. 17p. Dep. CFSTI. CAN $0.50.

The electronic and mechanical design, performance and application of a portable contamination meter are described. An appendix gives operating instructions and a setting up procedure. It also lists other ORNL health instruments to which the contamination meter may be connected. The meter has a linear count rate scale (0–1000 counts/minute) useful for locating low level contamination and a quasi-logarithmic scale (0–60,000 counts/minute) for measuring contamination levels. It can be connected to a thin-walled side- or end-window Geiger tube. Power is supplied by rechargeable batteries whose state is monitored continuously. It can be connected permanently to the charger for line-powered operation. (auth)

16076 (AECL-3224) GENERATION OF ELECTRON CURRENTS BY GAMMA-RAYS. Sovka, J. A.; Truant, P. T. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Nov. 1968. 53p. Dep. CFSTI. CAN $1.50.

Theoretical studies are reported of the production of electrons in a semi-infinite plate by gamma-rays interacting by Compton scattering and photoelectric absorption. Electron yields per incident photon were obtained as functions of γ-ray energies from 0.15 to 1.50 MeV, plate atomic numbers from 13 (aluminum) to 92 (uranium) and for plate thicknesses up to 1.5 g/cm^2. A limited comparison was made with results obtained from ^{60}Co Gamma-Cell experiments. The analytical investigations are helpful in describing the behavior of coaxial self-powered detectors operating in a similar γ-ray flux. Extension of the analysis to electron generation in a radiation field containing neutrons and γ-rays, as in a reactor core, is recommended. (auth)

16077 (CEA-CONF-1155) ASSEMBLY FOR DETECTION OF CHARGED PARTICLES AND GAMMA RAYS. Passerieux, J. P.; Fouan, J. P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 3p. (In French). (CONF-680906-14). Dep.

From International Symposium on Nuclear Electronics, Versailles, France.

The assembly for the detection of charged particles uses semiconductor detectors placed in the scattering chamber. The detectors, the preamplifiers, and the analysis amplifier are briefly described. For the detection of γ rays the assembly uses either Ge(Li) coaxial diodes or NaI(Tl) scintillators. (J.S.R.)

16078 (CEA-CONF-1179) STUDY OF TIME RESOLUTION IN GERMANIUM (Li) COAXIAL DETECTORS. Haouat, G.; Lachkar, J.; Sigaud, J. ([Commissariat a l'Energie Atomique, Paris (France)]). [1968]. 15p. (In French). (CONF-680906-17). Dep.

From International Symposium on Nuclear Electronics, Versailles, France.

A study was made to determine the quality of the time information that a large volume Ge(Li) coaxial detector open at both ends could provide. The distribution function of the pulses was determined. This makes possible the calculation of the mean value of the collection time and its fluctuations. The influences of the location of the detection, of the direction of the scattered electron, of the discrimination threshold, the polarization voltage, and the counting rate on the time definition are considered. The theoretical predictions are in good agreement with the experimental results. Some criteria of good operation are derived and justified. (tr-auth)

16079 (CEA-CONF-1181) SYSTEM FOR MEASUREMENT AND RECORDING TIME INTERVALS WITH RESOLVING POWER OF 10 ns. APPLICATION TO THE MEASUREMENT OF INSTANTANEOUS DETECTION OF FISSION NEUTRONS. Laget, J. P.; Fernier, Ph.; Frehaut, J.; Gauriau, J.; Labbe, J.; Soleilhac, M. ([Commissariat a l'Energie Atomique, Paris (France)]). [nd]. 15p. (In French). (CONF-680906-19). Dep.

From International Symposium on Nuclear Electronics, Versailles, France.

A system of fast digital chronometry and its application to the coding to the moments of detection of the neutrons emitted by fission are presented. Based on the principle of the direct counting of the time beginning with the origin moment, it is capable of coding the arrival moment of one to 16 pulses transported by a single cable. The precision in the time measurement can be fixed at 1 μsec or 10 to 100 nsec per channel. The separating power, defined as the minimum time between two pulses for the apparatus to give two distinct codings, is better than 10 nsec; if two pulses are too close in time, only the first is counted. The results are stored in a torus memory; each time measured is sent to an address which takes account of the total number of pulses coded during the analysis. The apparatus was realized completely in integrated circuits. (tr-auth)

16080 (CEA-CONF-1189) INDUSTRIAL NUCLEAR ELECTRONIC DEVELOPMENTS OF THE C. E. A. Normand, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Aug. 20, 1968. 72p. (In French). (CONF-681122-1). Dep.

From Conference on Scientific Instruments for Measurement and Control, Novosibirsk, USSR.

Industrial development of nuclear electronics in France is summarized. Development of radiation detectors, associated electronics in drawers or cabinets, functional elements of fast electronics, and multiunits and control instrumentation is discussed. The most important developments in each field are described and the principal characteristics are given. (J.S.R.)

16081 (CEA-R-3559) ADJUSTMENT OF A DIRECT METHOD FOR THE DETERMINATION OF MAN BODY BURDEN IN ^{239}Pu BY X-RAY DETECTION OF ^{235}U. Boulay, Pierre (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). Nov. 1968. 92p. (In French). Dep.

Thesis. Submitted to Univ. of Paris, France.

The use of ^{239}Pu on a large scale presents a problem concerning the contamination measurement at lung level. Direct measurement of ^{239}Pu lung burden is described using a large area window proportional counter. The adjustment of the apparatus allows an adequate sensitivity to detect contamination at the maximum permissible body burden level. Also, a method for individual internal calibration with a plutonium mock: the protactinium-233, is reported. (auth)

16082 (COO-1472-22) DIGITAL COMPUTER ANALYSIS AND DISPLAY OF THE RADIOISOTOPE SCAN. Groome, David S.; Brown, Donald W. (Colorado Univ., Denver. Medical Center). Jan. 27, 1969. Contract AT(11-1)-1472. 55p. Dep. CFSTI.

After a brief summary of the equipment used for data collection and processing the various types of displays such as two-dimensional printer displays, two-dimensional printer displays with photography, isometric printer displays, and plotter displays are discussed. Data smoothing of isometric data is briefly examined. A method by which hidden lines have been removed from some of the isometric plots of scan data is described. (B.G.D.)

16083 (COO-1472-23) [COMPUTER ANALYSIS OF THE RADIOISOTOPE SCAN.] Technical Progress Report. [Brown, Donald W.; Groome, David S.] (Colorado Univ., Denver. Medical Center). Feb. 5, 1969. Contract AT(11-1)-1472. 24p. Dep. CFSTI.

An on-line computer system based on the IBM 1800 computer for analysis of data from radioisotope scanners is described. (B.G.D.)

16084 (DPSPU-68-11-4) PORTABLE MONITOR FOR TRITIUM IN AIR. Goodwin, W. L. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Plant). Mar. 1968. 8p. Dep. CFSTI.

A portable monitor has been developed which accurately measures tritium concentrations between 1×10^{-4} and 1×10^{-1} μCi/cc of air. The instrument consists of five basic sections: air pump, deionizer, ionization chamber, logarithmic electrometer amplifier, and high voltage power supply. An internal rechargeable 12-volt battery powers the entire monitor. A connector is provided so that an external 12-volt battery can be used if the monitor is needed for extended periods of time. Total weight of the unit is 22 pounds and the overall dimensions are $10.5 \times 6.8 \times 13.2$ inches. The instrument has been calibrated by comparison with a Kanne monitoring system and evaluated under varying levels of tritium activity. Readings were reproducible within ±10% of reading. (auth)

16085 (EGG-1183-2138) PRELIMINARY MANUAL FOR OCTANT RADIATION DETECTOR. Number S-317-MN. Santarosa, J. F.; Applebay, G. W.; Couchman, J. C. (EG and G, Inc.,

Santa Barbara, Calif.). June 30, 1967. Contract AT(29-1)-1183. 26p. Dep. CFSTI.

The design, calibration, and operation of a scintillation detector system for aerial tracking of airborne radioactivity are presented. (W.H.K.)

16086 (EGG-1183-2172) NEUTRON COUNTING EFFICIENCY AND CHARGED PARTICLE RESPONSE OF AN NE-213 FLUOR DETECTOR. Technical Report Number S-413-R. O'Dell, A. A.; Sandifer, C. W.; Knowlen, R. B. (EG and G, Inc., Santa Barbara, Calif.). Jan. 22, 1968. 35p. Dep. CFSTI.

Using the Van de Graaff accelerator facilities at Texas Nuclear Corporation and the Los Alamos Scientific Laboratory, the absolute neutron-detection efficiency and charged-particle response of an NE-213 scintillation detector for neutron energies ranging from 0.2 to 20 MeV were measured. Neutron fluence was measured with a fission chamber and with a long counter, both of which were calibrated with a proton-recoil telescope. Time-of-flight techniques were used to reject pulses generated in the detector by scattered neutrons and gamma-rays. Neutron detection efficiency was measured for detector bias levels corresponding to electron energies of 14 ± 4 and 31 ± 1 keV, as determined by observation of Compton pulse-height spectra from monoenergetic gamma-ray sources. The agreement between the measured efficiency data and calculations based on a single-collision model considering (n,p), $^{12}C(n,n)$, and $^{12}C(n,\alpha)$ reactions is within the estimated experimental error of ±8%. Analysis of the Compton pulse-height spectra shows that NE-213 has a linear response to electrons with energies greater than approximately 150 keV, and that the pulse height at the high-energy half-intensity point of the Compton distribution is equivalent to 1.05 ± 0.01 times the Compton edge energy. Measured proton response values for NE-213 are in good agreement with previously reported measurements above 3 MeV; however, for lower proton energies, disagreement on the order of 30% is observed. Apparatus and measurement techniques are described, and a method for calculating detector efficiency for arbitrary bias levels is presented. (auth)

16087 (EGG-1183-2183) INVESTIGATION OF PERFORMANCE OF PIN SILICON DETECTORS. Technical Note Number S-67-TN. Stevens, J.; Knowlen, R. B.; John, W. (EG and G, Inc., Santa Barbara, Calif.). June 1968. Contract AT(29-1)-1183. 29p. Dep. CFSTI.

Three types of pulsed measurements were performed to determine the performance of PIN silicon detectors used to measure x-ray flux. The first was a time-response measurement for 5-nsec x-ray excitation. The second measurement was the determination of the effect of pulse width on detector sensitivity, which was made for pulse widths between 5 nsec and 4 μsec. The third measurement was the effect of peak output current on the detector linearity. (B.G.D.)

16088 (N-68-31552) DEVELOPMENT OF A BREADBOARD MODEL OF AN ALL-PNEUMATIC NEUTRON FLUX DETECTOR. Final Report. Milleman, S. E. (Rocketdyne, Canoga Park, Calif.). May 23, 1968. Contract 3-7989. 160p. (NASA-CR-72422; R-7492). CFSTI.

A breadboard model was constructed of an all-pneumatic neutron flux detector. Subassemblies of the detector consisted of a sensing element which was electrically heated to simulate neutron heating effects, a precooler, a temperature equalizer, and a fluid interaction logarithmic function generator. The detector was designed to produce a pneumatic output signal proportional to the logarithm of incident neutron flux. Performance tests were made on all system subassemblies except the sensing element. Sensing element heater development tests were completed. (auth)(STAR)

16089 (N-68-34489) IMAGE INTENSIFIER PHOTOGRAPHY OF SIMULATED SHOWERS IN LARGE AREA LAYERS OF PLASTIC SCINTILLATORS. Huggett, R. W.; Sandor, T.; Webb, J. E. (Louisiana State Univ., Baton Rouge. Dept. of Physics and Astronomy). [1967]. 14p. (NASA-CR-87752). CFSTI.

From 10th International Conference on Cosmic Rays, Calgary, Alberta, Canada.

Preliminary results are presented of some tests which were made to determine the feasibility of using an image intensifier camera to photograph showers developing within an ionization calorimeter containing large sheets of plastic scintillator. In the tests the camera is used to view the shorter edge of a sheet of Pilot Y plastic scintillator 91.5 cm × 183 cm and 2.5 cm thick. Showers of various sizes occurring within the scintillator are simulated by a nanosecond light source of appropriate size which is inserted into holes in the scintillator. The tests show that with the optical system anticipated to be used in the final application the threshold for shower detection seems to be sufficiently low and the image size sufficiently small to enable the system to be used over the required depth of field to obtain space and energy resolution of showers that occur simultaneously within the calorimeter with energies around 10 TeV. (auth) (STAR)

16090 (ORNL-4335, pp 2-11) PULSE COUNTING AND ANALYSIS. (Oak Ridge National Lab., Tenn.).

Developments in preamplifier technology are summarized including a linear broadband current-sensitive preamplifier for fission fragment analysis, a charge-sensitive preamplifier for fast timing applications with Ge(Li) and silicon detectors, and a charge-sensitive preamplifier containing a positive feedback loop. Also, time-variant filters for generating bipolar pulses, transient analysis of transistorized logarithmic amplifiers, a zero-crossover timing discriminator, a gated pulse shaper, a neutron spectrometer for balloon operation, a three-detector neutron time-of-flight system, rise-time calculations for an overdamped second-order response, a Moessbauer spectrometer with constant velocity or acceleration modes, and a low-level gamma spectrometer for the Lunar Receiving Laboratory are briefly discussed. Other developments outlined include a linear electronic chopper and shaper for sliding pulse generator, synthesis of a directly doupled wideband delay-line bridge with high gain stability, a computer-aided study of a 600-MHz decade scaling system, and a G-M tube checker. (W.H.K.)

16091 (ORNL-4335, pp 20-4) DETECTORS OF IONIZING PARTICLES AND RADIATION. (Oak Ridge National Lab., Tenn.).

Detector development is outlined and includes germanium purification, germanium detectors using gamma-ray compensation, cryostats for lithium-drifted germanium detectors, position sensitive detectors of ionizing radiation using rise-time measurement, alpha scintillation detector, plutonium-239 fission chamber, parallel plate boron trifluoride pulse chamber, monitor alpha emitters in stack effluent, low-radioactivity cans for thallium-activated sodium iodide detectors, large-volume scintillators and associated electronics, and statistical analysis of a scintillator-photomultiplier timing system. (W.H.K.)

16092 (ORNL-4335, pp 25-33) RADIATION MONITORING. (Oak Ridge National Lab., Tenn.).

Development of radiation monitoring systems at ORNL is outlined. Also, a transistorized five-decade log electrometer, recycling ionization chamber, neutron criticality monitor, modular transistorized radiation monitor unit for constant air monitor, iodine monitor, modular laundry monitor, cesium-137 dose ratemeter and scanner, gamma spectrometer for spectral analysis of MSRE cell during shutdown, and closed-circuit television viewing in maintenance of radioactive systems are briefly discussed. (W.H.K.)

16093 RADIATION DETECTING DEVICE. Meinig, Karl-Heinz. U. S. Patent 3,422,286. Jan. 14, 1969. Priority date Jan. 5, 1965, Germany.

A sample handling and radiation detecting device having horizontally moving sample cassette with vertical hole for receiving samples together with a sample transporter and means for guiding movement of the cassette to move the samples to a radiation detector having a crystal forming a part thereof. (U.S. Pat. Gazette)

16094 INSTRUMENTS FOR MEASURING γ AND β RADIATION. Deme, Sandor (Central Research Inst. for Physics, Budapest). Fiz. Szemle, 18: 313-16(1968). (In Hungarian).

The instruments used for control and for experimental purposes include ionization chambers, GM counters, scintillation chambers, etc. The instruments must cover a broad range of activity, from background level to an upper limit of as much as 1000 R/hr; however, no single instrument must cover as much as 8 orders of magnitude. Instruments based on an ionization chamber are used to measure γ radiation within a wide range. Scintillation detectors possess the highest sensitivity. The GM counter is the most widely used instrument; it is very versatile and may be used for dose-rate determination and for measuring surface contamination. In some instruments, excessive radiation causes overloading which prevents the recording of any radiation. Use of an absorbent may be helpful to determine whether the reading is due to β radiation emitted by the surface or the γ activity of the surrounding medium. Semiconductor detectors are receiving increasing application in nuclear physics. In some types of instruments, the readings are not displayed in a digital manner but a light or sound signal is used to indicate the level. (TTT)

16095 ON COUNTING PRECISION AND THE S^2/B CRITERION. Putman, J. L. (United Kingdom Atomic Energy Authority, Wantage, Eng.). Int. J. Appl. Radiat. Isotop., 20: 205(Mar. 1969).

Porges (loc. cit. 19: 711(1968)) sounds a warning against indiscriminate use of the S^2/B criterion for the choice or adjustment

of counting equipment, particularly when S is not $\ll$ B, and reference suggests that a previous publication by the present author advocates the wide use of this criterion. In fact, the paper cited (loc. cit. 13: 99 and 222(1962)) is not directly concerned with this, but related to the signal counting rate necessary for measurement with a given precision in the presence of background, when a limited time T is available, with relevance to determining the total amount of radioactivity needed in a practical tracer experiment once the detector sensitivity and background are known. The two communications are thus complementary, and if an apparent error in Porges' derivation is corrected, they can also be shown to be compatible. (auth)

16096 USE OF A SEMICONDUCTOR PROBE FOR DOSE-RATE MEASUREMENTS DURING INTRACAVITARY IRRADIATION. Parker, R. P.; Johnson, P. F.; Baker, Joan W. (Royal Marsden Hospital, Sutton, Eng.). Brit. J. Radiol., 42: 69-70 (Jan. 1969).

A brief description of small coaxial p–n silicon detectors for measuring the radiation dose to the rectum and bladder during intracavitary irradiation of the uterus and cervix in patients with gynecological cancer is given. (W.H.K.)

16097 CONCERNING THE OPERATION OF CHERENKOV DETECTORS TOGETHER WITH SPARK CHAMBERS. Abdullaev, A. M.; Gorbovskii, V. M.; Yuldashbaev, T. S. (Inst. of Nuclear Physics, Ulugbek, USSR). Prib. Tekh. Eksp., No. 6, 90-2(Nov.-Dec. 1968). (In Russian).

The operation of Cherenkov detectors together with spark chambers is discussed. It is shown that the spark chamber has an effect on the recording of the amplitude distribution of pulses from the photomultiplier tube of the Cherenkov detector. (tr-auth)

16098 FAST PREAMPLIFIER FOR TIMING OF SIGNALS FROM SEMICONDUCTOR DETECTORS. Lanko, E. V.; Dombrovskaya, G. S. (Inst. of Nuclear Physics, Alma-Ata, USSR). Prib. Tekh. Eksp., No. 6, 93-5(Nov.-Dec. 1968). (In Russian).

A fast preamplifier using high-frequency transistors for obtaining timing signals with semiconductor detectors is described. The timing of signals is realized with a pulse transformer. The time resolution is $\leq$22 nanoseconds. The rise time of the pulse is approximately 3.0 nanoseconds. The amplification of the preamplifier is ~150. The preamplifier works in combination with a slow charge-sensitive preamplifier. (tr-auth)

16099 GEIGER COUNTERS FOR PHOTONS AT 8 TO 14 AND 44 TO 60 A. Sorokin, L. S.; Dmitriev, A. B.; Chaikovskii, V. G.; Tindo, I. P. (Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 6, 174-6(Nov.-Dec. 1968). (In Russian).

A Geiger counter with a window of large surface area prepared from thin films and aluminum foils is described. (tr-auth)

16100 APPARATUS FOR THE DETERMINATION OF SMALL CONCENTRATIONS OF TRITIUM. Bystritskii, V. M.; Mekhedov, B. N.; Mekhedov, V. N. (Voronezh State Univ., USSR). Prib. Tekh. Eksp., No. 6, 70-2(Nov.-Dec. 1968). (In Russian).

An apparatus is described for determining the accumulation of tritium in targets which were irradiated by high-energy particles. The apparatus consists of a system for separation of tritium by filters and detectors and scintillation detectors and shielding for separation from background produced by cosmic radiation. The scintillation detector comprises a mixture of H_2 and alcohol with forcible quenching. The volume of the detector is 200 cm^3 and the background is 6 counts/min. (tr-auth)

16101 EFFICIENCY OF RECORDING SHOWER PARTICLES IN MULTILAYER SPARK CHAMBERS. Gapotchenko, A. G.; Govorkov, B. B.; Denisov, S. P.; Starostin, S. S. (Inst. of Physics, Moscow). Prib. Tekh. Eksp., No. 6, 58-60(Nov.-Dec. 1968). (In Russian).

The efficiency of multilayer spark chambers for recording secondary particles, which were formed by 200-MeV electrons in lead, is investigated. It is shown that the efficiency does not depend on the number of tracks r (for $2 \leq r \leq 5$) and the distances between them (within the limits 3–30 mm), but does depend on the increase in the difference between the slopes of particle trajectories and the direction of the electric field in the chamber. The insulation of the electrodes does not lead to a noticeable increase in efficiency. (tr-auth)

16102 ASSEMBLING AND MECHANICAL TREATMENT OF BLOCKS OF NUCLEAR EMULSIONS. Baranov, V. I.; Marin, I. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 6, 61(Nov.-Dec. 1968). (In Russian).

A simple system is described for assembling emulsion chambers by means of joining mechanically treated ends of a pile of emulsion layers. The mechanical treatment (milling) of emulsion blocks is examined. (tr-auth)

16103 PREVENTION OF THE COAGULATION OF GRAINS OF MICRODISPERSED POWDER INTRODUCED IN NUCLEAR EMULSIONS. Kulikova, N. M.; Nikitina, N. V.; Romanova, T. A.; Uvarova, V. M. (Inst. of Physics, Moscow. All-Union Scientific Research Inst. of Chemico-Photographic Industry, Moscow). Prib. Tekh. Eksp., No. 6, 62-3(Nov.-Dec. 1968). (In Russian).

A method for preventing coagulation of grains of microdispersed powder based on the application of anionic surface-active substances is described. In the case examined, approximately 95% of the grains (by dimension $\leq$1 micron) being introduced in nuclear emulsions kept initial dispersion. (tr-auth)

16104 RECORDING OF CHARGED PARTICLES WITH CELLULOSE NITRATE. Abdullaev, Kh.; Perelygin, V. P.; Tretyakova, S. P.; Shadieva, N. Kh. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 6, 64-6(Nov.-Dec. 1968). (In Russian).

A method for recording light charged particles with cellulose nitrate is described. The threshold sensitivity of cellulose nitrate for alpha particles is $\leq$2.2 MeV and the efficiency of recording of such particles is (90 ± 7)%. The possibilities of using cellulose nitrate to record heavier particles is discussed. The effect of prolonged storage is also examined. (tr-auth)

16105 FLUORESCENT SCANNING: A MEDICAL APPLICATION OF FLUORESCENT SPECTROSCOPY. Hoffer, Paul B. (Univ. of Chicago, Argonne Cancer Research Hospital, Chicago). Isotop. Radiat. Technol., 6: 292-4(Spring 1969).

X-ray fluorescence has been used in organ scanning, producing images of the organs studied, by using the radiation from a ^{241}Am source. Examples are presented of thyroid and liver scans produced with a fluorescent scanner. (auth)

16106 RECENT ADVANCES IN SCANNING. Harper, P. V. Jr.; Gottschalk, A.; Beck, R. N. (Argonne Cancer Research Hospital, Chicago). Isotop. Radiat. Technol., 6: 295-304(Spring 1969).

The status of the art of scanning in medical diagnosis is presented. The factors important in scanning, such as pharmaceutical agents and isotopes, scanners, and pathological conditions, are discussed both individually and interdependently. (auth)

16107 THE DEPENDENCE OF THE MEAN LIFETIME OF THE EXCITED STATE AND THE PHOTOLUMINESCENCE YIELD OF ANTHRACENE ON THE CONCENTRATION OF IMPURITIES PRODUCED BY IRRADIATION. Khan-Magometova, Sh. D. Opt. Spectrosc. (USSR) (Engl. Transl.), 25: 203-5 (Sept. 1968).

Translated from Opt. Spektrosk., 25: 373-7(Sept. 1968).

The dependence of the mean lifetime of the excited state τ during the photoluminescence of anthracene on the concentration of quenching impurities produced by ionizing radiation has been studied. Earlier, in a previous work investigating the reduction in photoluminescence yield of a number of molecular crystals under electron irradiation, changes were observed in the shape of the luminescence spectra of the irradiated crystals. An attempt is made to explain both the results obtained earlier and the observations of the concentration dependence of τ. (auth)

16108 RADIATION DETECTOR AND RECORDER. Bate, L. C.; Dyer, F. F.; Thacker, L. H. (to United States Atomic Energy Commission). U. S. Patent 3,431,414. Mar. 4, 1969.

A sentinel-type radiation detector is provided which is quite useful in detecting and recording the occurrence of pulses of radiation together with information indicating the time of the occurrence. A microcoulometer is employed in conjunction with a scintillator for indicating time of radiation occurrence. Light from the scintillator passing through the aperture of the coulometer and a scaled mask is recorded on photographic film. (AEC)

16109 GAMMA-RAY CAMERA FOR IMAGING RADIOISOTOPE DISTRIBUTION IN A TRANSVERSE SECTION OF A ROTATING SUBJECT. Anger, Hal O. (to United States Atomic Energy Commission). U. S. Patent 3,432,660. Mar. 11, 1969.

A radiation detector for showing the distribution of a radioactive substance in a transverse section of a subject which uses a radiation camera with oscillographic readout is described. The subject is rotated while viewed by the radiation camera which is focused in the plane of the section and unfocused in the transverse plane. An image of scintillations detected in the camera is formed on an oscilloscope and projected through a cylindrical lens onto a photographic film rotated in synchronism with the subject. (AEC)

16110 AUTOMATIC SEPARATION COLUMN PRODUCT ANALYZER. Walker, Robert J. (to United State Atomic Energy Commission). U. S. Patent 3,432,662. Mar. 11, 1969.

A monitor is described for scanning, from outside, the contents of a chromatographic separation column for radioactive values, featuring a solid-state neutron detector adapted to move along the length of the column, together with sequence of an amplifier, pulse-height discriminator and noise eliminator, count-rate averaging circuit, and a signal amplitude indicator. (AEC)

16111 INSTRUMENTATION IN NUCLEAR MEDICINE. Miio, Masahiro (Tokyo Univ.). Iyo Denshi To Seitai Kogaku, 6: 116-28(Apr. 1968). (In Japanese).

A survey of the instrumentation in nuclear medicine is presented. Instrumentation is divided into two categories, one for the in vitro measurement and the other for the in vivo measurement. For the in vitro measurement of medical samples the simplified well counter and the programmed well counter were recently introduced. These are to meet the need of the expanding diagnostic use of the thyroid function test in many hospitals and for quick handling of medical samples to assess the circulating blood volume in emergency cases. The advantages and importance of large volume detectors are emphasized. Instrumentation for radioisotope chromatography, liquid scintillation spectrometry, and neutron activation analysis in the in vitro measurement of nuclear medicine is also discussed. For in vivo measurement, the scintillation scanner and the γ camera show sophistication in design. Varieties of external γ counters and whole body counter are discussed including the catheter type semiconductor radiation detector for the in vivo measurement of cardiac output and upper GI tract malignancy. (NSA of Japan)

16112 TRITIUM MONITOR BASED ON SCINTILLATION. Moghissi, A. A.; Kelley, H. L.; Phillips, C. R.; Regnier, J. E. (Southeastern Radiological Health Lab., Montgomery, Ala.). Nucl. Instrum. Methods, 68: 159(Feb. 1, 1969).

A scintillation detection system with increased sensitivity for monitoring tritium in air, water, and urine is described. (B.G.D.)

16113 THE EFFECT OF FISSION DELAYED GAMMA RAYS ON MEASUREMENTS OF $\bar{\nu}_p$ PERFORMED WITH LARGE LIQUID SCINTILLATION DETECTORS. Walton, R. B.; Sund, R. E. (Gulf General Atomic Inc., San Diego, Calif.). Nucl. Instrum. Methods, 68: 163–4(Feb. 1, 1969).

Estimates are made of the effect of fission delayed gamma rays on $\bar{\nu}_p$ measurements performed with large liquid scintillation detectors; these calculations are based on delayed gamma-ray data obtained over the last few years. (auth)

16114 ^{152}Eu AS A CALIBRATION SOURCE FOR Ge(Li) DETECTORS. Mukherjee, P.; Sengupta, A. K. (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Instrum. Methods, 68: 165-6 (Feb. 1, 1969).

The relative intensities of ten prominent gamma rays of ^{152}Eu (12.4 y) are given which can be used to obtain promptly the relative photopeak efficiency of a Ge(Li) gamma detector. (auth)

16115 COSMIC-RAY TELESCOPE EMPLOYING DETECTORS IN THE SHAPE OF A SPHERICAL SEGMENT. Perkins, M. A.; Kristoff, J. J.; Mason, G. M.; Sullivan, J. D. (Univ. of Chicago). Nucl. Instrum. Methods, 68: 149-52(Feb. 1, 1969).

A particle detector in the shape of a segment of a spherical shell is described. When used as a detector element in a charged particle telescope and with an isotropic source of particles (as in interplanetary space) the geometrical factor of the telescope may be two to four times that obtained from a telescope using the same diameter plane circular detectors. In addition, improved resolution over the plane circular detector results because of less variation in relative path length for particles of various angles of incidence traversing the detector. Li-drifted silicon detectors of this shape have been fabricated with electrical and particle characteristics identical to flat wafer detectors. (auth)

16116 THE ATTENUATION OF PROPORTIONAL COUNTER PULSES BY RC AMPLIFIER TIME CONSTANTS. Kemshall, C. D.; Beauchamp, K. G.; Benjamin, P. W. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Nucl. Instrum. Methods, 68: 153-6(Feb. 1, 1969).

Measurements have been made, using an analog computer, of the attenuation of a proportional counter wave form by an amplifier having equal RC time constants. Data are given which enables the pulse attenuation to be obtained for any counter geometry and any equal RC time constants. (auth)

16117 EMPIRICAL PHOTOFRACTIONS FOR NaI(Tl) SCINTILLATION CRYSTALS. Steyn, J. J. (NUS Corp., Washington, D. C.); Andrews, D. G. Nucl. Instrum. Methods, 68: 118-24 (Feb. 1, 1969).

A procedure for representing both experimental and Monte Carlo NaI(Tl) crystal gamma photon photofractions by a simple continuous function is given. Empirical equations based on a modified existing expression and published Monte Carlo photofraction data are presented for right-cylindrical crystals ranging from $\frac{1}{2}'' \times \frac{1}{2}''$ to $8'' \times 8''$, a number of detection geometries and the energy range $\approx$0.2 to 6.0 MeV. The variation of photofraction with incident beam collimation is given. (auth)

16118 CALIBRATION OPTIMIZATION IN LIQUID SCINTILLATION. Fogel, G. (SHARP Labs, La Jolla, Calif.). Nucl. Instrum. Methods, 68: 125-30(Feb. 1, 1969).

Radioisotopes for technical and scientific research are used more and more in industrial and scientific laboratories. Scientists are designing and improving radiation counting techniques. Two types of progress are indicated. Methods of sample preparation and many different components of liquid scintillation are discussed. Several techniques have been developed: some simple, and others more sophisticated. Also a continuous improvement of the instrumentation for radionuclide detection and measurement has been made. This second type of progress is studied. (auth)

16119 CHARACTERISTICS OF PLASTIC SCINTILLATORS IN THEIR USE AS LARGE AREA PARTICLE DETECTORS. Walker, J. K. (Harvard Univ., Cambridge, Mass.). Contract AT-(30-1)-2752. Nucl. Instrum. Methods, 68: 131-4(Feb. 1, 1969).

The characteristics of plastic scintillators of particular relevance to their use as large detectors are briefly discussed. In the last two years some new plastics have appeared on the market. Data on the relative light attenuation by these plastics measured under identical conditions for all the plastics are presented. The results are summarized together with some other important qualities of these plastics. It is hoped that these results will assist in the design of large area detectors. (auth)

16120 SCINTILLATION RESPONSE FUNCTION AND DECAY TIME OF CsI(Na) TO CHARGED PARTICLES. Keszthelyi-Landori, S. (Gamma Works, Budapest); Hrehuss, G. Nucl. Instrum. Methods, 68: 9-12(Feb. 1, 1969).

The response-energy function and scintillation pulse-shape of CsI (0.5% Na) have been measured for charged particles of different ionization density. The response-energy functions are very similar to those of CsI(Tl) while increasing steeper uniformly by a factor of about two. The scintillation decay consists of two exponential components with mean lives as 0.46 and 4.18 μs, respectively. The relative intensity of the components shows considerable ionization-density dependence. (auth)

16121 SYSTEM OF LARGE LIQUID SCINTILLATION COUNTERS USED WITH A SIMPLIFIED NEUTRON–GAMMA DISCRIMINATION TECHNIQUE. Bertin, A. (Univ., Bologna. Istituto Nazionale di Fisica Nucleare, Bologna); Vitale, A.; Placci, A. Nucl. Instrum. Methods, 68: 24-38(Feb. 1, 1969).

A system of NE 213 liquid scintillator neutron counters working with a straightforward neutron-gamma discrimination technique and a digitized data output is described. The apparatus was built up using only standard electronics, and has been working at CERN in recent muon capture experiments. The performances of the neutron counters are reported with particular reference to the neutron-gamma discrimination features and to the energy resolution. The calculation of the efficiency of the described system is also discussed. (auth)

16122 RADIOMETRIC DEVICE FOR DETERMINING THE ^{90}Sr CONTENT IN SEA WATER. Vakulovskii, S. M.; Silantev, A. N. (Inst. of Experimental Meteorology, Obninsk, USSR). Nucl. Instrum. Methods, 68: 42-4(Feb. 1, 1969).

A radiometric device for determining the ^{90}Sr content in seawater is described. The device, placed in a 15 cm steel shield, has 4 cph background, the counting efficiency of ^{90}Y being 50%. (auth)

16123 EXPERIMENTAL TECHNIQUES USED IN A PRECISION CHARGED PARTICLE ABSOLUTE CROSS SECTION MEASUREMENT. Mancusi, M. D.; Bair, J. K.; Jones, C. M.; Thornton, S. T.; Willard, H. B. (Oak Ridge National Lab., Tenn). Nucl. Instrum. Methods, 68: 70-6(Feb. 1, 1969).

In the course of a recent precision cross-section measurement utilizing solid-state detectors in a gaseous target scattering chamber, many effects which determine the shape and character of observed spectra were investigated experimentally. Data are presented on (1) slit edge scattering, (2) gas target scattering compensation processes, (3) detector efficiency, (4) gas scattering

spectrum shape, (5) solid state detector response, and (6) incoming beam energy degradation. (auth)

16124 ELECTRON–GAMMA ANGULAR CORRELATION ARRANGEMENT USING SEMICONDUCTOR COUNTERS. Bosch, H. E. (IIAE, Buenos Aires); Gatto, L. F.; Behar, M.; Garcia, G. J. Nucl. Instrum. Methods, 68: 88-92(Feb. 1, 1969).

An electron-gamma angular correlation arrangement using a lithium-drifted semiconductor counter as electron detector is presented. This was placed together with a field-effect transistor in a cylindrical rotating vacuum chamber cooled at a temperature of 200°K through a cold-finger system. Three scintillation counters set at right angles complete the system. Three coincidence circuits were used together with a routing system, in order to display three different electron-conversion spectra in memory subgroups of a multichannel analyzer. A resolution of 0.6% was obtained at 1 MeV, thus permitting the separation of the three main conversion lines of both cascades of 570 and 1064 keV from the decay of ^{207}Bi. Electron-gamma coincidences at three different angles were simultaneously recorded in the particular case of the above cascades. Values of A_2 coefficients for the three shells for both correlations are also presented. (auth)

16125 LOW-LEVEL ALPHA MONITOR (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1883).
10 drawings.

A reliable low-level α counter for urine analysis is described. The alpha survey meter Q-1975B (see CAPE-1148) was modified and repackaged in a NIM module for this purpose. The NIM container is 68.6 mm (2.699 in.) by 132.3 mm (5.209 in.). (For details see TID-4100 Suppl. 51.) (F.S.)

16126 GAMMA ION CHAMBER (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1830).
5 drawings.

An improved general purpose gamma ionization chamber is described. The weldable header assembly has two ceramic-to-metal sealed coaxial feedthroughs. Each feedthrough will mate with a standard inexpensive SM-type coaxial cable connector. (For details see TID-4100 Suppl. 51.) (F.S.)

16127 EVACUATED ALPHA CHAMBER (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1831).
2 drawings

An evacuated alpha chamber designed to measure the activity on thinly plated ^{210}Po sources (~16 Ci) is described. The source is mounted on the signal electrode and enclosed in a high-voltage shell. There is no gas for ionization so the current is due to the collected alpha charge. A safety shorting switch is provided to prevent high-voltage buildup due to alpha charge and interelectrode capacitance. The stainless steel evacuated chamber is contained in a stainless steel breaker. (For details see TID-4100 Suppl. 51.) (F.S.)

16128 DETERMINATION OF DETECTION EFFICIENCIES OF NaI SCINTILLATION DETECTORS FOR GAMMA-RAY SOURCES DISTRIBUTED IN WATER. Moriuchi, Shigeru; Matsushita, Kozo (Japan Atomic Energy Research Inst., Ibaraki). Radioisotopes (Tokyo), 18: 1-7(Jan. 1969). (In Japanese).

Measurements for determining detection efficiencies of three NaI scintillators having dimensions of 1 in. $\phi \times 1$ in. to 2 in. $\phi \times 2$ in. were made for various gamma-ray sources distributed uniformly in water tanks. Gamma-ray energies are ranged between 0.13 MeV and 1.84 MeV, and water tanks are cylindrical ones having the diameter equal to the depth. Results were expressed by approximation formulae as a function of radii of volume-equivalent spherical water tanks, and the responses in infinite water volume were extrapolated. Counting efficiencies for a unit gamma emitter per unit volume can be calculated by this equation with reproducing errors of ±5%. The energy response was fairly flat over a wide energy range with a small tank of about 20 cm in radius, independent of the size of scintillator. Furthermore, photon number buildup factors were derived from the formula and compared with those calculated from energy buildup factors given by Goldstein, et al. The values obtained experimentally were about one half of Goldstein's. This fact implies that it would cause big errors in the determination of counting efficiencies of gamma detectors to use the buildup factors for photon numbers calculated from those for energy or dose. (auth)

16129 HIGH VOLTAGE SUPPLY FOR RADIATION DETECTING EQUIPMENT. Jones, Alun R.; Gedcke, Dale A. (to Atomic Energy of Canada Ltd.). U. S. Patent 3,428,807. Feb. 18, 1969. Filed Mar. 1, 1965.

A transistorized high voltage supply for radiation detector tubes in which the high voltage is produced by the multiplication and rectification in a Cockcroft-Walton multiplier of an ac signal produced by a blocking oscillator whose free-running frequency is low is described, and a control circuit is used which accelerates the frequency of operation of the blocking oscillator each time a pulse in the tube occurs by varying the resistance of the rc circuit which determines the oscillator's free-running frequency. (Official Gazette)

16130 RADIODIAGNOSTIC SCANNER WITH SEPARATELY MOVING SCINTILLATOR DETECTORS. Donato, Luigi; Gennaro, Gianni; Giordani, Roberto (to EURATOM). U. S. Patent 3,428,805. Feb. 18, 1969. Priority date Aug. 17, 1965, Italy.

A radiodiagnosis apparatus comprising at least three pairs of coaxially opposed scintillators is described. Each pair of scintillators is mounted with its axis parallel to that of the other pairs and is carried by an individual carriage. Automatically operated motion control means provide for synchronous movement of all carriages, as well as for individual control means for each carriage. (Official Gazette)

16131 ELECTRONIC LABORATORY TECHNIQUES. Price, L. W. London, Churchill Ltd., 1969. 271p. 40s.

A section is included on nuclear measurements, including descriptions of the Geiger tube, gas flow counting, ionization chambers, scintillation counting, solid-state detectors, ratemeters, scaling and display circuits, data print-out, the magnetic beam switching tube, anti-coincidence circuits, coincidence circuits, liquid scintillation counter background, pulse amplification, proportional amplifiers, pulse spectra, amplifier characteristics, pulse height analysis, the Schmitt trigger discriminator, the tunnel diode discriminator, multi-channel analysis, liquid scintillation counter spectrometers, pulse summation, quenching, electronic calculators, computer techniques, solid scintillation spectrometers, activation analysis, Moessbauer spectrometry, etc. (UK)

Nuclear Spectroscopic Instrumentation

16132 (EGG–1183-2176) A COMPUTER PROGRAM FOR ANALYZING GAMMA-RAY PULSE-HEIGHT SPECTRA MEASURED WITH SCINTILLATION COUNTERS. Technical Report Number S-415-R. Taherzadeh, M.; Sandifer, C. W. (EG and G, Inc., Santa Barbara, Calif.). July 1968. 67p. Dep. CFSTI.

A response matrix was formed for a 5- by 6-inch NaI detector and used to obtain gamma energy spectra from measured pulse-height distribution. All of the computer codes used in these calculations were written for the CDC-3600 computer and added to the computer programs written by C. D. Zerby of Oak Ridge National Laboratory and by C. V. Smith and N. E. Scofield of the U. S. Naval Radiological Laboratory. The matrix-inversion and iteration methods were both included among the programs, and the user has a choice of using either or both of these two methods. (auth)

16133 (EGG–1183-2179) NaI SPECTROMETER MEASUREMENT OF THICK-TARGET BREMSSTRAHLUNG AT ELECTRON ENERGIES ABOVE 5 MeV. Technical Report Number S-417-R. Sandifer, C. W.; Taherzadeh, M. (EG and G, Inc., Santa Barbara, Calif.). July 1968. Contract AT(29-1)-1183. 34p. Dep. CFSTI.

Thick-target bremsstrahlung spectra produced by electron bombardment of a 0.2 radiation length gold-tungsten target were measured for electron energies in the range of 5.3 to 20.9 MeV. A large NaI spectrometer coupled to a pulse pile-up rejection system measured pulse-height distributions for bremsstrahlung emitted in the forward (zero-degree) direction, and a response matrix developed for the spectrometer was used to convert pulse-height distributions into photon energy spectra. The shapes of the measured spectra show good agreement with those obtained by others for the same target configuration. Apparatus and experimental methods are described, and thick-target bremsstrahlung spectra are presented for electron energies of 5.3, 10.0, 14.8, 16.4, 18.2 and 20.9 MeV. (auth)

16134 (IITRI–578-P-33-3) DEVELOPMENT OF NEUTRON SPECTROMETRY FOR CRITICAL FACILITIES. Quarterly Report No. 1, October 1–December 31, 1968. Semmler, R. A. (IIT Research Inst., Chicago, Ill.). Jan. 1969. Contract AT(11-1)-578. 24p. Dep. CFSTI.

A quarterly progress report on the development of a wall-less proportional counter for neutron spectrometry is presented. Primary work was on the electronic system. A new electronic system using gated current pulses was assembled and was shown to operate at substantially higher rates (30,000–50,000/sec) than previously possible. In addition, a new gas filling system was built.

Work on refurbishing the wall-less proportional counter is in progress. (auth)

16135 (JUL-534-CA) 2 θ VALUE FOR THE X-RAY SPECTRAL ANALYSIS WITH LITHIUM FLUORIDE, (200), 2d = 4.0276 Å AS THE ANALYZER CRYSTAL. Freiburg, C.; Reichert, W (Kernforschungsanlage, Juelich (West Germany). Zentrallabor fuer Chemische Analyse). June 1968. 58p. (In German). Dep

The 2-θ values, arranged according to increasing wavelength, are presented for a lithium fluoride crystal (200), 2d = 4.0276 Å. The element symbols of the wavelength, the order of the crystal refraction, and the wavelength in angstroms are also given in the table. In Table II the 2-θ values are arranged according to increasing atomic number of the element. (J.S.R.)

16136 (JUL-536-CA) 2 θ VALUE FOR X-RAY SPECTRAL ANALYSIS WITH TOPAZ, (303), 2d = 2.712 Å AS ANALYZER CRYSTAL. Freiburg, C.; Reichert, W. (Kernforschungsanlage, Juelich (West Germany). Zentrallabor fuer Chemische Analyse). June 1968. 45p. (In German). Dep.

The 2-θ values, arranged according to increasing wavelength, are tabulated for a topaz crystal (303), 2d = 2.712 Å. The element symbols of the wavelength, the order of the crystal refraction, and the wavelength in angstroms are also given in the table. In Table II the 2-θ values are arranged according to increasing atomic number of the element. (J.S.R.)

16137 METHOD FOR DETERMINING PARAMETERS OF THE TOTAL ABSORPTION PEAK. Gribkov, A. K.; Soshin, L. D. (Belorussian State Univ., Minsk). Prib. Tekh. Eksp., No. 6, 41-3(Nov.-Dec. 1968). (In Russian).

Simple mathematical expressions are presented for determining directly from experiments parameters of the total absorption peak. The expressions also provide the possibility of evaluating the statistical error for these parameters. It is shown that for the utilization of obtained ratios a minimum of three experimental points are necessary. The application of the coordinates of the maximum point of the total absorption peak and other mathematical models of the peak, in particular the parabola, are discussed. (tr-auth)

16138 APPLICATION OF A SUMMING COMPTON SPECTROMETER FOR STUDYING THE RESOLUTION OF NaI(Tl) MONOCRYSTALS. Mokhir, E. P.; Tsirlin, Yu. A.; Antufev, Yu. P. (All-Union Scientific Research Inst. of Monocrystals, Kharkov). Prib. Tekh. Eksp., No. 6, 53-5(Nov.-Dec. 1968). (In Russian).

Using a summing Compton spectrometer, an experimental investigation was conducted for determining the resolution of NaI(Tl) scintillation spectrometer. The resolution is shown to depend on the luminescence properties of the crystal, the energy of the electrons, and the number of Compton interactions with complete absorption of gamma quanta. (tr-auth)

16139 MOESSBAUER SPECTROMETER WITH CONSTANT ACCELERATION. Voronin, A. M.; Kaipov, D. K.; Shalabaev, D. A. (Inst. of Nuclear Physics, Alma-Ata, USSR). Prib. Tekh. Eksp., No. 6, 56-8(Nov.-Dec. 1968). (In Russian).

A Moessbauer spectrometer with constant acceleration is described. A rate reference signal is provided by an electromechanical vibrator through an amplifier. Using this signal a coupling between the frequency of oscillation of the vibrator and the frequency of switching of channels in multichannel analyzers exists. (tr-auth)

16140 APPARATUS FOR NEUTRON SELECTION BY MEANS OF ROTATING SWITCH ROTOR. Will, Walter; Geist, Heinz; Krebs, Karlheinz (to EURATOM). U. S. Patent 3,427,455. Feb. 11, 1969. Filed Apr. 25, 1966.

An apparatus for neutron selection comprising a neutron chopper whose rotor is vertically suspended and driven from a drive motor by a flexible drive shaft, a cradle means adapted to receive and to rotatably support the rotating rotor upon the unexpected occurrence of a rupture in said shaft. (Official Gazette)

16141 SEMICONDUCTOR X-RAY EMISSION SPECTROMETER. Bowman, Harry R.; Thompson, Stanley G.; Hyde, Earl K.; Jared, Richard C. (to United States Atomic Energy Commission). U. S. Patent 3,433,954. Mar. 18, 1969.

A new type of x-ray emission spectrometer is described which incorporates high-resolution semiconductor detectors and specialized preamplifier circuitry in the detector system to provide a compact and economical instrument for rapid, non-destructive chemical analysis of materials. (AEC)

16142 METHODS OF NEUTRON SPECTROSCOPY. Buras, B. (Univ., Warsaw). pp 443-82 of Theory of Condensed Matter. Vienna, International Atomic Energy Agency, 1968.

See STI/PUB-205.

Three lectures are presented which give an overall, general, and up-to-date account of the principles of the methods of neutron spectroscopy. The first lecture, which is of introductory character, is devoted to a brief review of the basic experimental methods of neutron spectroscopy and illustrates the usefulness of the reciprocal lattice concept for the description of neutron diffraction phenomena. The second lecture deals with methods of neutron spectroscopy for structure analysis of solids and the third shows how neutrons can be used for studies of lattice dynamics. (B.G.D.)

16143 MISSING-MASS SPECTROMETER WITH DETECTION OF TWO OUTGOING PARTICLES. Bressani, T.; Charpak, G.; Favier, J.; Massonnet, L.; Meyerhof, W. E.; Zupancic, C. (CERN, Geneva). Nucl. Instrum. Methods, 68: 13-23(Feb. 1, 1969).

The experimental set-up used to study the π^+ absorption in flight by complex nuclei with two outgoing protons is described. The momentum of the incident pion is measured by a magnetic spectrometer, and the momenta of the two outgoing protons by a range array of 48 plastic scintillators, each 2 mm thick. The directions of the particles are measured by film-less spark chambers. An on-line computer system allows a continuous control of the data which are finally recorded on magnetic tape. (auth)

16144 A STUDY OF THE VARIANCE-COVARIANCE MATRIX FOR GAMMA-RAY SPECTRA. Eckhoff, N. D. (Kansas State Univ., Manhattan). Nucl. Instrum. Methods, 68: 93-102(Feb. 1, 1969).

The probability distribution function of the counts in the various channels of gamma-ray spectra were studied by accumulating an experimental frequency function for each channel. The standard variance assumption for data from a radioactive source was investigated. Finally, a variance-covariance matrix for the gamma-ray spectra was calculated. These results indicate that most of the standard assumptions, e.g., normality and uncorrelated data, are valid for gamma-ray spectra. (auth)

16145 LINE SHAPE ANALYSIS OF SPECTRA OBTAINED WITH Ge(Li) DETECTORS. Huang, F. C. P.; Osman, C. H.; Ophel, T. R. (Australian National Univ., Canberra). Nucl. Instrum. Methods, 68: 141-8(Feb. 1, 1969).

Line shape analysis techniques have been applied to gamma ray spectra obtained with a Ge(Li) detector. It was found that least-squares fitting procedures enabled more accurate and rapid extraction of relative intensities than was possible from the areas of the full energy or double escape peaks. (auth)

16146 A NOTE ON THE WALFORD-DOUST METHOD FOR RAPID CALIBRATION OF GERMANIUM SPECTROMETERS. Dolev, A.; Adam, G.; Katriel, J. (Nuclear Research Centre-Negev, Beer Sheba, Israel). Nucl. Instrum. Methods, 68: 176 (Feb. 1, 1969).

It is noted that in the Walford-Doust method some corrections should be made for the efficiencies determined from photons originated from cascade transitions. (auth)

16147 METHOD OF AND APPARATUS FOR STABILIZING THE GAIN OF NUCLEAR PULSE SPECTROMETERS. Comunnetti, Angelo (to Gesellschaft zur Forderung der Forschung an der Eidgenossischen Technischen Hochschule). U. S. Patent 3,428,804. Feb. 18, 1969. Priority date June 4, 1964, Switzerland.

A method is described of stabilizing the overall gain of nuclear spectrometers and particularly those of the scintillation type wherein a mechanically chopped reference source is used to control the system gain by pulse-difference feedback in such manner that complete separation of the reference spectrum from the spectrum to be analyzed is obtained. (Official Gazette)

High Energy Physics Instrumentation

Refer also to abstract 17038.

16148 (CEA-CONF-1127) STUDY OF ANALOG SIMULATION OF THE EXPANSION SYSTEM OF THE "GARGAMELLE" HEAVY LIQUID BUBBLE CHAMBER. Bezaguet, A. (Ecole Polytechnique, Paris (France). Laboratoire de Physique des Hautes Energies); Deat, M.; Tellier, N. (Commissariat a l'Energie Atomique, [Paris] (France)); Queru, P. (Ecole Polytechnique, Paris (France). Laboratoire de Physique des Hautes Energies). [nd]. 32p. (In French). (CONF-680941-6). Dep.

From International Symposium on Analogue and Hybrid Computation Applied to Nuclear Energy, Versailles, France.

The Gargamelle, a bubble chamber filled with heavy liquids such as propane or freon, is briefly described. The expansion system and the initial concept of the control system are described in some detail. A mathematical model of the expansion system is presented. Three calculation phases are distinguished: tests of degenerate systems, study of the free system, and control chains with study of the control system. The results of the analog study are given and the most significant conclusions are discussed. (J.S.R.)

16149 (CONF-680628) PROCEEDINGS OF THE INTERNATIONAL COLLOQUIUM ON PEPR, NIJMEGEN, NETHERLANDS, 5–7 JUNE 1968. (Nijmegen Univ. (Netherlands)). 1968. 142p. Dep.

Separate abstracts were prepared for each of the papers presented. (B.G.D.)

For abstracts of individual papers see: 16150–16157.

16150 (CONF-680628–, pp 5-18) THE PEPR POINT GUIDANCE SYSTEM AT M.I.T. Bastien, P. L.; Brooks, C.; Cormack, J.; (and others) (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science).

The PEPR Point Guidance System at M.I.T. is now operating in full production mode. The instantaneous measuring rate is ~200 events (triads)/hour, including track density measurements. The average rate over an 8-hour day, including film and tape handling is about 75 to 100 events/hour. The precision of measurement is about two times better than conventional hand-measurements. Twenty thousand events of π^+p interactions (all topologies) at 3.9 BeV/c have been successfully measured. (auth)

16151 (CONF-680628, pp 19-45) THE STATUS OF THE YALE PEPR SYSTEM. Bogert, D.; Lucas, P.; Taft, H. (Yale Univ., New Haven, Conn.).

A review of the status of the PEPR at Yale University is presented. Topics include present hardware and differences from M.I.T., calibration, general operating programs, and specific event type programs and physics with PEPR to date. (auth)

16152 (CONF-680628–, pp 46-58) OXFORD PEPR STATUS AND FUTURE DEVELOPMENT. Brooks, C. B.; Davey, P. G.; Harris, J. F. (Oxford Univ. (England)).

The development status of the Oxford PEPR equipment is presented. The hardware performance mainly in relation to the problem of getting reasonable results with 20 micron bubbles in a rather large format (50 × 120 mm) is examined. The future development of a second scanning system is discussed. (B.G.D.)

16153 (CONF-680628–, pp 59-71) NIJMEGEN PEPR STATUS. Helder, J. C.; Hendriks, J. H. G.; Raaijmakers, M. C.; Schotanus, D. J.; Van de Walle, R. T. (Nijmegen Univ. (Netherlands). Fysisch Laboratorium).

Nijmegen ordered its PEPR hardware in the strict sense, i.e., the controller, the DAC's, the drivers, and the TED's, from ASTRODATA. This equipment was connected to an IBM 360/50 via a PDP-7 satellite computer, a setup different from the other existing PEPR groups. The operation status of this equipment is discussed. Topics include the experience with the ASTRODATA equipment to date; the merits and the disadvantages of our setup with an intermediate PDP computer, and differences in the MIT design resulting from it; and performance and timing of the PDP–IBM data-link. (auth)

16154 (CONF-680628–, pp 72-103) POLLY I: AN OPERATOR-ASSISTED BUBBLE CHAMBER FILM MEASURING SYSTEM. Barr, R.; Clark, R.; Hodges, D.; Loken, J.; Manner, W.; Musgrave, B.; Pennock, P.; Royston, R.; Wehman, R. (Argonne National Lab., Ill.).

A new computer-controlled, bubble chamber film measuring device has been designed, constructed and has been in use since July, 1967. It uses a cathode ray tube as the digitizing light source. The unit of measurement is a slice scan which is the flying spot digitization of a small variable-sized rectangular area that can be oriented in any one of 32 equally spaced directions around 360°. Facilities are provided for an operator to view the picture currently being measured and to engage in an efficient dialogue with the control computer. Measurement of film is controlled by computer programs and has proceeded at a maximum rate of 60 two-prong events per hour, with the computer requesting operator assistance when required. A coordinate precision of about ±2 microns on 70 mm film is attained. (auth)

16155 (CONF-680628–, pp 119-25) THE NIJMEGEN 7" C.R.T. PEPR. Raaijmakers, M. C.; Van de Walle, R. T. (Nijmegen Univ. (Netherlands). Fysisch Laboratorium).

The two PEPR systems now operational at M.I.T. and at Yale, use a 5-in. C.R.T. and are equipped with 2 to 1 and 1.5 to 1 optics respectively, i.e., only cover film formats up to a maximum of roughly 6 by 6 cm. The film format used at CERN for the 2 m hydrogen bubble chamber is 5 by 12 cm (or 5 by 14 cm if the data box is included). In order to use the present ASTRODATA hardware with the larger CERN film format a change was made over to an optical system without demagnification and a bigger 7-in. C.R.T. (auth)

16156 (CONF-680628–, pp 126-32) PRINCIPLE AND PROGRESS OF THE PATR SYSTEM. Sekely, M. E. (Princeton Univ., N. J. Palmer Physical Lab.).

The hardware of the PATR (Princeton Automatic Track Reader) which is a distortion-free cathode ray tube scanning system based on the MIT PEPR machine, with its universal applicability for both point processing and for line element filtering methods for pattern recognition and truck measurement, is described. (B.G.D.)

16157 (CONF-680628–, pp 133-40) RECENT DEVELOPMENTS AND FUTURE POSSIBILITIES IN FERRANTI C.R.T.'s AND ASSOCIATED COILS SUITABLE FOR BUBBLE CHAMBER FILM SCANNING. Woodcock, S. (Ferranti Ltd., Oldham (England)).

Recent developments in cathode ray tubes are discussed. The main components: bulb envelope, phosphor screen, and electron optics are examined. A method for measuring the resolution of CRT's is also presented. (B.G.D.)

16158 (JINR-P13-4191) ENGINEERING OF LARGE SPARK CHAMBERS AND POWER PULSE SUPPLYING GENERATORS. Baicher, K. A.; Zykin, Yu. N.; Nikanorov, V. I.; Nozdrin, I. Kh.; Pisarev, A. F.; Pisarev, V. F.; Tolstoi, N. S.; Filippov, V. N.; Sheshunov, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1968. 16p. (In Russian). Dep.

The technology of construction of one-gap spark chambers 150 × 150 × 2 cm in size is described. The chamber electrodes are made of thin foil. The devices for foil stringing and glass cutting, the table for stringing up the chambers as well as the vacuum system for filling and evacuation of large chambers are described. A high-voltage power generator for supplying large chambers is also described. (auth)

Radiation Dosimeters

16159 (BMwF-FBK-68-45) THE PERFORMANCE OF EXTENSIVE EXPERIMENTS ON GLASS DOSIMETERS BY THE OFFICIAL PERSONNEL DOSIMETRY SERVICE OF THE LAND BADEN-WUERTTEMBERG. Marier, E.; Narrog, J. (Landesinstitut fuer Arbeitsschutz und Arbeitsmedizin, Karlsruhe (West Germany)). Sept. 1968. 88p. (In German). Dep.

Film dosimetry, also used in the Federal Republic of Germany as official personnel dosimetry has been exposed to stronger criticism since the development of glass dosimetry. Phosphate-glass dosimeters were tested together with γ-β film-badges in our laboratory and in practical use for their ability as routine personnel dosimeters. The results showed that glass dosimeters are superior to film-badges for the measurement of quantum radiation in the energy range between 45 keV and Co-60. However, if glass dosimeters are carried for a period shorter than 3 months, film-badges are more economical. (auth)

16160 (CEA-CONF-1087) ENERGY LOSSES OF ELECTRONS IN MATERIAL: METHOD OF CALCULATION AND RESULTS. Bertel, E.; Joffre, H.; Pages, L.; Sklavenitis, L. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 14p. (In French). (CONF-681013-2). Dep.

From 1st European Congress on Radiation Protection and Exhibition on Equipment Using Low Energy and Short Range Radiation Dosimetry, Menton, France.

The study of tissue equivalent materials for dosimeters necessitates the determination of certain physical characteristics of the mixtures studied or developed and, particularly, the electron stopping power in these materials. In order to determine the stopping power, the energy losses by ionization and bremsstrahlung were calculated separately. The energy losses by ionization were calculated from the Bethe slowing down theory. Moreover, in order to take account of the density effect, the usual empirical functions used were avoided by beginning with the base functions established by Fermi. The energy losses by emission of bremsstrahlung were calculated according to the formulas proposed by Koch and Motz. A calculation program was developed and written in Fortran IV for an IBM 360-75. This program made it possible to calculate the stopping powers, the paths, and the bremsstrahlung yields of electrons, with energy between 10 keV and 100 MeV, particularly for all the elements capable of interfering in the development of tissue equivalent mixtures. (tr-auth)

16161 (CEA-CONF-1088) IONIZATION CHAMBERS WITH SOFT TISSUE-EQUIVALENT WALLS FOR MEASUREMENT OF ABSORBED DOSES OF LOW-ENERGY PHOTONS. Vialettes, H.; Grand, M.; Petit, G. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 20p. (In French). (CONF-681013-5). Dep.

From 1st European Congress on Radiation Protection and Exhibition on Equipment Using Low Energy and Short Range Radiation Dosimetry, Menton, France.

Ionization chambers designed to replace the Philips and Baldwin chambers usually used for dosimetry in the x-ray beam are described. The material constituting the walls is equivalent to the air for photons with energy between 10 keV and 10 MeV and thus permits a direct measurement of the absorbed dose in the soft tissues with a maximum error of 10% throughout this energy range. The isotropic response of the chambers was improved by spherical geometry. For dosimetry in scattered beams, necessitating wider sensitivity ranges, chambers were developed using the same principles but with larger volumes. Chambers of 12 l were constructed with a sensitivity of the order of 2×10^{-12} amp/mRad hr^{-1} in air and with an isotropy of 10% on 300° for 27-keV photons. The measurements made on these chambers are presented and the results obtained are compared with those obtained with classical chambers, particularly with respect to the energy and isotropic responses. The attenuation curves of the materials constituting the walls are given for different operational modes of the x-ray generator. (tr-auth)

16162 (CEA-CONF-1099) PERFORMANCE AND AREAS OF APPLICATION OF NEW RADIOPHOTOLUMINESCENT GLASSES. Chapuis, Anne Marie; Sigli, Paul; Francois, Henri; Nicodeme, Nicole; Carpentier, Serge; Delarue, R. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1968]. 9p. (In French). (CONF-680302-9). Dep.

From International Symposium on Nuclear Electronics and Radioprotection, Toulouse, France.

Five new radiophotoluminescent glasses, whose compositions are covered by patents, were investigated. The glasses contain, in varying ratio, $LiPO_3$, $Be(PO_3)_2$, $NaPO_3$, $Al(PO_3)_3$, and $AgPO_3$. The sensitivity of the glasses to γ radiation, x radiation, thermal neutrons, fast neutrons, and protons at 3 GeV was investigated. The mean predose of the glasses (the intensity of the fluorescence measured on a dosimeter before any irradiation) was determined for the five glasses. (J.S.R.)

16163 (NYO-3409-7) ROLE OF TRAPPING PROCESSES IN SOLID STATE RADIATION DOSIMETRY. Progress Report, 1968-69. (Pennsylvania State Univ., University Park. Materials Research Lab.). Feb. 1969. Contract AT(30-1)-3409. 30p. Dep. CFSTI.

A survey of the research done and the present status of research on trapping processes in pyroelectric and nonpyroelectric materials, especially ZnS, is presented. Published papers prepared from the results obtained from this research are appended. (B.G.D.)

16164 (RD/B/N-693) LITHIUM FLUORIDE THERMOLUMINESCENT DOSIMETRY AND AN ASSESSMENT OF THE CON-RAD 5100 SYSTEM. Webb, G. A. M. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Nov. 1966. 32p. Dep.

The behavior of lithium fluoride, both in loose powder form and incorporated into Teflon discs, has been determined for a wide range of environmental conditions. A new annealing procedure for Teflon discs is shown to eliminate the difficulties associated with low-temperature peaks previously observed in their glow curves. The stability and reproducibility of the readout instrument has been studied. An improved method for establishing the heating conditions on all instruments of this type is given, together with data on the precision of measurements at various dose levels. The response to x and gamma radiation over an energy range from 30 keV to 20 MeV and a dose range from 10 mR to 1000 R is given. The response to other radiations, including beta-particles, alpha-particles, fast and thermal neutrons is discussed, and shown to agree with the gamma response on an energy deposition basis, provided that linear energy transfer (LET) and range effects are taken into account. A complete lithium fluoride dosimetry system as provided by Controls for Radiation Inc. has been assessed. (auth)

16165 SCINTILLATION DOSIMETER FOR GAMMA-AND X-RAY DOSE-RATE MEASUREMENTS. Arsaev, M. I.; Osipov, B. F.; Sulimova, N. E.; Krasnikov, V. A. Prib. Tekh. Eksp., No. 6, 66-70(Nov.-Dec. 1968). (In Russian).

A scintillation dosimeter is described for gamma- and x-ray dose-rate measurements at energies of 30-300 keV and dose rates of 0.1 to 300 mR/sec. The variation with rigidity in the indicated range of quanta energy is ±10-15%. The dosimeter is practically insensitive to fast neutrons. (tr-auth)

16166 IMPROVEMENTS IN OR RELATING TO DOSIMETRY TECHNIQUES. Perry, Kenneth Edward Gordon (to United Kingdom Atomic Energy Authority). British Patent 1,143,941. Feb. 26, 1969. Filed Apr. 5, 1965.

It is stated that a disadvantage of the normal thermoluminescence dosimetric technique is that a proportion of the stored energy emitted as light from the irradiated thermoluminescent material on heating may not represent emission of stored irradiation energy, but may arise from spurious effects not concerned with radiation dose. The most significant light emission resulting from irradiation energy occurs within a fairly narrow temperature range and emission above this range is due mainly to spurious effects, while that below this range cannot be directly related to dose received. A dosimeter system is proposed which includes means for heating the thermoluminescent material through the appropriate temperature range, a transducer for converting the emitted light energy into electrical current, means for converting this current into a succession of electrical pulses, and means for obtaining a value from these pulses which is a representative measure of received dose. Means are provided for integrating the light output over substantially only that part of the heating cycle in which the light emitted, in relation to radiation dose, is stable with respect to time. (UK)

Radiometric Instruments

16167 (N-68-26665) RADIOACTIVE-TYPE DUAL ABLATION MEASURING SYSTEM. VOLUME 1. Final Report. Bartley, John D. Jr. (Emerson Electric Co., St. Louis, Mo. Electronics and Space Div.). Jan. 15, 1968. Contract NAS1-5342. 100p. (NASA-CR-66630). CFSTI.

The feasibility of using a nucleonic technique for continuous and simultaneous measurement of ablative heat shield total and virgin material recession at the same flight vehicle location was investigated. The concept makes use of the chemical and nuclear properties of two radioactive compounds and of the fact that the radioactive intensity of these two compounds incorporated into an Ablation Sensor Plug, composed of the parent heat shield material, is related to the two thicknesses to be measured. Two radioactive chemical compounds were found, minute amounts of which could be incorporated into phenolic nylon and phenolic graphite without altering the ablative properties of these heat shield materials. Ablation tests demonstrated that the intensity of radiation remaining of one compound, $^{95}NbZr$, was proportional to the total heat shield thickness while that of the other compound, ^{114m}In, was proportional to the virgin material thickness remaining. (auth) (STAR)

16168 GAMMA-RAY UNIT FOR THERMAL PROTECTION OF BOILERS ON THE BASIS OF LEVEL. Aman, E. A. Elektr. Sta., No. 4, 75-6(Apr. 1967).

A thermal protective system using gamma-ray units has been operated for an extended period of time on TP-17 boilers of the Pribaltiiskaia State District Power Plant. The results indicate the reliability and the advantages of these units over other protection methods. The use of the gamma-ray units meets the requirements imposed on thermal protective devices for reliability, operating precision, performance, and adjustment. (auth)

16169 RADIATION GAUGE FOR IMPROVING THE DIMENSIONAL ACCURACY OF STEEL SHEETS. Cless-Bernert, Traude; Frevert, E.; Reisenauer, K. Berg- Huettenmaenn. Monatsh., 113: 162-6(Mar. 1968). (In German).

The apparatus described was specially designed for the accurate, contactless control of the thickness of rolled high-speed steel sheets up to 600 mm wide and 0.63-0.8 mm thick. The instrument, based on radiation absorption from a ^{90}Sr source, can determine the dimensional accuracy of the sheet to better than 1% in a measuring time of 1 sec. (Metals Abstr.)

16170 GAGE DEVICE FOR MEASUREMENT OF DENSITY PROFILES OF SNOWPACK. Smith, James L.; Willen, Donald W. (to United States Atomic Energy Commission). U. S. Patent 3,432,656. Mar. 11, 1969.

A moisture measuring system is described in which a radioisotope gamma radiation source and a radiation detector are moved continuously and simultaneously along spaced parallel paths in a moisture containing solid deposit so that the gamma radiation passes through narrowly defined successive incremental portions of the deposit. Means are provided for determining the intensity of radiation transmitted directly therebetween as well as for discriminating against radiation transmitted indirectly

through the deposit and for plotting radiation intensity of the directly transmitted radiation which varies as an accurate measure of the moisture distribution in said deposit. (AEC)

16171 APPARATUS FOR MEASURING THE HUMIDITY AND MASS OF SOILS. Wack, Bernard Francois (to Electricite de France (Service National)). U. S. Patent 3,428,806. Feb. 18, 1969. Priority date July 30, 1965, France.

An apparatus is described for measuring the humidity and mass of soil. The apparatus consists of a fast neutron source and a method for selective detection of neutrons of an energy greater than thermal neutrons. The detection device is comprised of a filter passing fast epithermal neutrons and a neutron detector, the filter being disposed between the volume of soil and the detector; a moderator material surrounding the detector; a gamma-ray source closely adjacent to the fast neutron source; and at least one gamma-ray detector located near the neutron detector and in the solid angle formed by the neutron source, gamma source, and neutron detector. (Official Gazette)

16172 CHANGES IN THE APPLICATION OF RADIOISOTOPES IN FRANCE DURING THE PERIOD 1961–1966. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.), Suppl. No. 73, 16–18 (Sept.-Oct. 1968). (In French).

The growth in the application of radioisotopes in France as reflected in replies to 967 questionnaires to public and private establishments on their use of radiation and radioisotopes is summarized. The total number of radiation gauges has doubled in five years. The number of tracer applications has declined, but the number of activation analyses has increased. An indication is given of the installation and operating costs of gauges. (J.S.R.)

Miscellaneous Instruments and Components

Refer also to abstracts 16059, 16090, 16290, 17084, 17251, and 17284.

16173 (CEA-CONF-1149) VISUAL FUNCTION GENERATORS IN CONJUNCTION WITH A HYBRID SYSTEM. Neyron, A. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [1967]. 15p. (In French). (CONF-680906-13). Dep.

From International Symposium on Nuclear Electronics, Versailles, France.

The specific needs in nuclear physics are reviewed: logarithmic plotting of spectra, isometric display, substraction of gaussian curves or even more simply the decimal display of lists of numbers. When taking into account technical requirements (working speed, etc.) one is naturally led to the generation of these functions by hardware. The so augmented display system has widened capabilities and versatility. By the association of a hybrid device having both a working station and a display station (polychromic display of 1.5×10^5 dots) the flicker effect is reduced whereas the conveniences for a versatile dialogue are preserved. (auth)

16174 (CEA-CONF-1201) 3 MeV–80,000 A–50 ns ELECTRON PULSE GENERATOR. Buchet, Jacques; Freytag, Jean-Pierre. [1967]. 5p. (In French). (CONF-681208-5). Dep.

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France.

The description of a generator designed to yield very high currents, (short impulsions 5.10^{-8} sec 80,000 A) is given. The electrons are produced by a field-emission device. The electron beam, slowed down through a high atomic number material, generates x rays at dose rates of 10^8 R s^{-1}, at a distance of 1 m from the target. The generator consists of four principal parts: one 200 kV dc supply unit, one voltage multiplier made up of 135 kJ condensers, one wave-shaping tuned circuit, and one electron tube. (auth)

16175 (EUR-4183) MAGNET CURRENT STABILIZER AND SCANNER FOR THE CEC MODEL 21-110 MASS SPECTROMETER. Mol, M. J. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Aug. 14, 1968. 27p. Dep.

The solid state magnet current stabilizer and scanner described delivers an adjustable current from 0.25 to 5 A to the deflection magnet of a mass spectrometer. Its current stability is better than 6 ppM/2 hours as required for the photographic recording of high resolution mass-spectra. The scan circuit provides purely exponential scanning in both the upward and downward direction with time constants selectable from 3.5 to 29,000 seconds to cover a wide range of scan speeds. Furthermore, cyclic scanning by repetitive small linear variations in magnet current is possible. (auth)

16176 (EURFNR-543) HYDRAULIC POTENTIOMETER AS A CONTROL ELEMENT AND TRAVEL INDICATOR. Muehlhaeuser, O. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente). Translation of report KFK-734. 78p. Dep. CFSTI.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

Results of a study to determine the natural limits of a hydraulic potentiometer and to investigate its drawbacks and indicate methods of removing them are presented. The potentiometers tested were part of a hydraulically actuated reactor control rod drive model. (W.H.K.)

16177 (N-68-31391) DEVELOPMENT OF LITHIUM DIFFUSED RADIATION RESISTANT SOLAR CELLS. Payne, P. (Heliotek, Sylmar, Calif.). July 15, 1968. Contract NAS7-100. 14p. (NASA-CR-96012; QR-1). CFSTI.

For Jet Propulsion Lab., Pasadena, Calif.

Various parameters of the lithium diffusion were investigated with respect to uniformity of the cell electric characteristics. A new lithium furnace was set up. Lithium diffusions were done in a helium atmosphere and compared to those done in a nitrogen atmosphere. Cell position on the diffusion boat during lithium diffusion was investigated with respect to cell electrical characteristics. Study of the effect of boron diffusion process parameters on lithium cell electrical characteristics was also started. Two shipments of sixty cells each have been fabricated and the first has been submitted to JPL for radiation testing. Yield analyses have started and will be done for each shipment of cells. This analysis is expected to be a valuable tool in analyzing progress with respect to process control and in selecting optimum parameters. (auth) (STAR)

16178 (N-68-33767) TRANSISTOR DESIGN EFFECTS ON RADIATION RESISTANCE. Berggren, C. C.; Honnold, V. R. (Hughes Aircraft Co., Fullerton, Calif.). Sept. 1968. Contract NAS1-6954. 97p. (NASA-CR-1167). CFSTI.

Analytical expressions relating transistor design parameters to radiation induced gain degradation were developed. Emitter efficiency and base transport injection level effects have received prime consideration. Several statistically designed experiments, which employed custom designed planar transistor variations, were conducted to evaluate the theoretical conclusions. The need for accurate profile information to correlate with radiation induced gain degradation is established. Shallow junctions and low base doping are shown to contribute significantly to radiation resistance. (auth) (STAR)

16179 (N-68-34283) LITHIUM-DIFFUSED SOLAR CELLS. Quarterly Report, April 1–June 30, 1968. Kendall, Don L.; Fisher, James K. (Texas Instruments Inc., Dallas). July 1968. Contracts NAS7-100; JPL-952248. 13p. (NASA-CR-96807; QR-1). CFSTI.

For Jet Propulsion Lab., Pasadena, Calif.

Recovery data of previously produced lithium-diffused solar cells were analyzed after irradiation with high-energy electrons. These analyses resulted in a change in the type of cell blank used for lithium diffusion. Solar cells were made of two of the three major types of silicon, namely, quartz-crucible, and Lopex. Electrical characteristics of these cells are presented. Future cells will be fabricated using float-zoned silicon, as well as varied base and doping processes. Also, several samples of lithium-diffused silicon of various resistivities were prepared in a Hall bar configuration and tested. (auth) (STAR)

16180 (NIRS-7, pp 3-11) PHYSICS. (National Inst. of Radiological Sciences, Chiba (Japan)).

Research in physics at the National Institute of Radiological Sciences during 1967 is reported. The research includes a new detection method of small ionization current based on oscillation of a dynamic capacitor, measurement of plutonium lung burden in vivo, high-sensitivity continuous plutonium air monitor, experimental determination of energy spectrum of megavolt x rays, neutrons from thick-target beryllium (d,n) reactions at 1.0 to 3.0 MeV, attenuation of high energy x rays, energy dependence of LiF, CaF_2, and $CaSO_4$(Mn) thermoluminescent dosimeters for high-energy electrons, estimation of gamma dose from neutron-induced radioactivity in Hiroshima and Nagasaki, and fast neutron dose distribution in tissue-equivalent phantom. (B.G.D.)

16181 (NVO-1163-156) APPLICATION OF NON-STATIONARY PROCESSES TO GENERATE SYNTHETIC SEISMOGRAMS. Beaudet, Paul R.; Hays, Walter W.; Lynch, Robert D.; Williams, Spencer

L. (Environmental Research Corp., Alexandria, Va.). Dec. 19, 1968. Contract AT(29-2)-1163. 47p. Dep. CFSTI.

The concept and design of a time-varying analog filter for generating synthetic seismograms which approximate real seismograms observed from underground nuclear explosions is given. The basic design of this filter exploits a non-stationary characteristic commonly observed on seismograms; i.e., the progressive transformation with time from relatively high frequency ground motion in the P and S wave windows to the relatively low frequency ground motion in the surface wave window of the seismogram. The control parameters of the time varying analog filter were determined on the basis of measurements made from the radial component of fifty seismograms representative of a wide source energy and distance range. Control parameters were determined for both hard rock and alluvium station sites. These parameters control the time-varying response of the analog filter to a white noise input. The response of the filter is a member of an ensemble of synthetic particle velocity seismograms representative of a specified yield and source-station site distance. Particle acceleration and displacement synthetic seismograms are obtained by simultaneous differentiation and integration on the synthetic particle velocity seismogram. Comparison of PSRV spectra generated from a synthetic seismogram to PSRV spectra generated from an observed seismogram having equivalent yield, recording station distance, and station site geology parameters indicates that the synthetic seismograms generated with the time varying analog filter are reasonably close approximations to real seismograms having equivalent parameters. (auth)

16182 (ORNL-4335) INSTRUMENTATION AND CONTROLS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 1, 1968. Sadowski, G. S. (comp. and ed.) (Oak Ridge National Lab., Tenn.). Feb. 1969. Contract W-7405-eng-26. 126p. Dep. CFSTI.

Separate abstracts were prepared for the 14 sections presented. (W.H.K.)

For abstracts of individual sections see: 16090–16092, 16183–16192, and 17024.

16183 (ORNL-4335, pp 1) NANOSECOND CIRCUITRY AND TECHNIQUES. (Oak Ridge National Lab., Tenn.).

Developments in the accurate calibration of coaxial delay lines and the design of a digital time intervalometer for measuring time intervals of a millisecond or less are summarized. (W.H.K.)

16184 (ORNL-4335, pp 12-18) MISCELLANEOUS ELECTRONICS DEVELOPMENT. (Oak Ridge National Lab., Tenn.).

Electronics development at ORNL is briefly described including a FET linear electrometer, high-energy magnet pulser, radiation effects on solid-state devices, NIM program, subaudio amplifier, high-voltage power supply for a zone refiner, pulsed power supply for electrofishing, battery charger for the neutron criticality monitoring system, a versatile millivolt source, x-ray source emission regulator, rf supply for ultraviolet lamp, orientation and guidance system for balloon experiments, a gated neutron monitor, and engineering support for the ORNL civil defense project. (W.H.K.)

16185 (ORNL-4335, pp 19) INSTRUMENTS FOR BIOMEDICAL RESEARCH. (Oak Ridge National Lab., Tenn.).

The development of a detection system to be used in the crystal structure determination of biomolecules by neutron diffraction is summarized. The system consists of a neutron-sensitive phosphor, image intensifier, television camera, and digital memory. It is designed to count thermal neutrons scattered from a sample irradiated by a beam of neutrons and to provide two-dimensional position information. (W.H.K.)

16186 (ORNL-4335, pp 34-42) AUTOMATIC CONTROL AND DATA ACQUISITION. (Oak Ridge National Lab., Tenn.).

Developments in computer-based systems for automatic control and data acquisition are summarized. Also, instrumentation for a gas chromatograph, use of a ten-channel high-speed data acquisition system, automatic control system for a microfiche printer, film badge reader and card punch system, strip-chart recorder curve integrator, and a data collection system for littoral transport studies are briefly discussed. (W.H.K.)

16187 (ORNL-4335, pp 43-50) DATA COLLECTION AND ANALYSIS. (Oak Ridge National Lab., Tenn.).

Developments in computer-based data acquisition and analysis systems are outlined. Process interfaces, development of electric furnace mathematical models, programming and maintenance support of the MSRE computer, and construction and verification of a thermocouple table are briefly discussed. (W.H.K.)

16188 (ORNL-4335, pp 51-9) PROCESS INSTRUMENTATION AND CONTROL SYSTEMS ENGINEERING. (Oak Ridge National Lab., Tenn.).

Developments are summarized including instrumentation at the Transuranium Processing Plant, shutdown of the Fission Products Development Laboratory for maintenance, thorium–uranium fuel cycle development facility, plutonium sol-gel microsphere program, instrumentation for the hyperfiltration desalination loop, uranium storage facility, and Pu-solex development laboratory instrumentation. Also, development of an improved anemometer, process instrumentation for operating reactors, fuel rod assembly for the Containment Research Installation, documentation of ORNL steam plant instrumentation, process instrumentation for the TLPR primary cooling system, calibration of vacuum gages, and instrument apprentice training are briefly discussed. (W.H.K.)

16189 (ORNL-4335, pp 60-71) PROCESS INSTRUMENTATION DEVELOPMENT. (Oak Ridge National Lab., Tenn.).

Developments in process instrumentation are summarized including a precision barometric pressure recorder–transmitter, an aerodynamic flux detector, prototype instruments for the analysis of body fluids, an electronic weighing system for a high-temperature isopiestic unit, detectors for liquid chromatography, temperature sensors for the LMFBR program, the FFTF coolant thermometry program, a weld current relay, high-speed analog data acquisition, and an infrared spectrometer environmental sample chamber. (W.H.K.)

16190 (ORNL-4335, pp 72-101) REACTOR INSTRUMENTATION AND CONTROLS. (Oak Ridge National Lab., Tenn.).

Development and maintenance of reactor instrumentation and control systems at ORNL for the period ending September 1, 1968, are summarized. (W.H.K.)

16191 (ORNL-4335, pp 108-13) INSTRUMENT DEPARTMENT MAINTENANCE AND SERVICE. (Oak Ridge National Lab., Tenn.).

Maintenance and service of the radiation monitoring systems and radio communications systems at ORNL are briefly described. Also, the design of a control panel for the Tower Shielding Facility, development of time delay modules for the Chemical Technology Division, and electronic services for the Neutron Physics Division are discussed. (W.H.K.)

16192 (ORNL-4335, pp 114-16) INSTRUMENTATION FOR REACTOR DIVISION EXPERIMENTS AND TEST LOOPS. (Oak Ridge National Lab., Tenn.).

Instrumentation developments for reactor experiments and test loops are summarized including HRB5-1 irradiation experiment, vertical-tube evaporator pilot plant, liquid-metal corrosion loops, molten-salt reactor project forced circulation loop, fission products deposition loop, fluoroborate circulating loop, steam test facility, NASA dryer–superheater test, and GCR visco seal tester. (W.H.K.)

16193 (RISO-M-808) CHARACTERISTICS OF OPERATOR, AUTOMATIC EQUIPMENT, AND DESIGNER IN PLANT AUTOMATION. Rasmussen, Jens (Danish Atomic Energy Commission, Risoe. Research Establishment). Oct. 1968. 30p. Dep.

An attempt is made to formulate a simple functional model of a plant control system comprising instrumentation and operators. The model is used to discuss the allocation of tasks to operator, instrumentation and designer. (Denmark)

16194 (RISO-M-830) A SIMPLE DIGITAL TIMER. Jenkin, L. R. (Danish Atomic Energy Commission, Risoe. Research Establishment). Nov. 1968. 11p. Dep.

A digital timer is described, employing TTL integrated circuit logic, which achieves with simple circuits a clock rate of 10 MHz, almost the toggling limit of the flip-flops used. The method of setting the time delays from a remote control panel uses a sequential code, and withstands interference. The timer, control panel, and output pulse generators are easily changed for different delay sequences. (auth)

16195 (SC-DR-68-420) ELECTRON SPECTROMETER FOR CARIBOO-III. Raymond, F. M. (Sandia Labs., Albuquerque, N. Mex.). Sept. 1968. 40p. Dep. CFSTI.

The design of an electron spectrometer for Cariboo III is described including electronics and calibration. (auth)

16196 (SC-DR-68-873) ROLAMITE CASE METROLOGY BY GRAZING INCIDENCE INTERFEROMETRY. Roth, E. S. (Sandia Labs., Albuquerque, N. Mex.). Dec. 1968. 15p. Dep. CFSTI.

The use of grazing incidence interferometry to inspect the geometry of the rolamite pumper case is described. Pumper

cases made of four separate parts were used to evaluate the interferometry technique. This interferometry technique is an applicable test for any high quality surface with microinch surface finish and size requirements. It is particularly useful in determining the geometry of surfaces in physically inaccessible locations. Complete explanations of the interference phenomena are not included because this material is available in engineering textbooks. (auth)

16197 (UCRL-71325) REAL TIME ACQUISITION AND DISPLAY OF MASS SPECTRA. Siemens, P. D. (California Univ., Livermore. Lawrence Radiation Lab.). Jan. 10, 1968. 9p. (CONF-681207-2). Dep. CFSTI.

From Digital Equipment Computer Users Society Conference, San Francisco, Calif.

A program package has been developed to perform real time data acquisition and display from a mass spectrometer. In this particular case the data acquisition routine performs multi-summing-scaling, but with minor changes the package could do signal averaging or pulse height analysis. Through a keyboard monitor, the operator has complete control of the experiment with a variety of commands available to him. Among these are commands which provide for: control of the data acquisition, real time log or linear displays, data output on paper tape, teletype, DEC tape or Calcomp, and data reduction (peak stripping and the calculation of isotope ratios). (auth)

16198 MULTICHANNEL COUNTING SYSTEM. Zlobin, I. A.; Shaparenko, E. E. (State Scientific Research Inst. for Instrument Construction, Moscow). Prib. Tekh. Eksp., No. 6, 78-80(Nov.-Dec. 1968). (In Russian).

A multichannel counting system, which permits the continuous accumulation of information in 32 channels with final data processing in computers during measurements, is described. (tr-auth)

16199 MULTICHANNEL COUNTING SYSTEM BASED ON AI-256 ANALYZER FOR THE MEASUREMENT OF YIELDS OF PHOTONUCLEAR REACTIONS. Armenskii, E. V.; Balamatov, N. N. (Moscow State Univ.). Prib. Tekh. Eksp., No. 6, 81-3(Nov.-Dec. 1968). (In Russian).

A system based on the AI-256 pulse analyzer is described for measurement of yields in photonuclear reactions. The resolving time of the system is 1 μsec. Modifications were introduced in the AI-256 to permit operation in four regimes: multichannel counting, amplitude analysis, time analysis, and numerical analysis. (tr-auth)

16200 NANOSECOND TIME-OF-FLIGHT SPECTROMETER. Lapshin, V. G.; Petrukhin, V. I.; Rykalin, V. I.; Khazins, D. M.; Tsisek, Z. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 6, 48-52(Nov.-Dec. 1968). (In Russian).

A time-of-flight mass spectrometer was described. The spectrometer has the following characteristics: time resolution – 0.44 nanoseconds, time range – 70 nanoseconds, travel distance – 4 to 14 m, and diameter of scintillator of second detector – 16 cm. The spectrometer which encompasses feedback stabilizes the time spectra during many hours of operation with an accuracy of ± 3 nanoseconds. (tr-auth)

16201 THE ABERRATIONS OF MAGNETIC SPECTROMETERS WITH HOMOGENEOUS FIELD AND DOUBLE FOCUSING FOR PARTICLES WHICH EMERGE FROM A SOURCE OF FINITE DIMENSION. Afanasev, N. G.; Goldshtein, V. A. (Physical-Technical Inst., Kharkov). Prib. Tekh. Eksp., No. 6, 44-8(Nov.-Dec. 1968). (In Russian).

Expressions accurate to third-order terms for the horizontal and vertical aberrations of particles which emerge from a source of finite dimension and move in a sector homogeneous magnetic field were derived from calculations of regional fields. A method for determining the distribution of particles in the vertical plane was presented. (tr-auth)

16202 IMPROVEMENTS IN OR RELATING TO HIGH-SPEED CAMERAS. Huston, A. E.; Procter, D. A. (to United Kingdom Atomic Energy Authority). British Patent 1,143,444. Feb. 19, 1969. Filed Nov. 3, 1966.

Reference is made to high-speed cameras of the type employing electron image-tubes, as described in British Patent 1,016,930. The present invention relates to an improved waveform-generating circuit for operating the shutter and compensating plates, having lower power consumption and whose operation can be more readily initiated by an external trigger pulse, this being important in synchronising a sequence of photographs with the event being photographed. The circuit comprises an inductor connected in parallel with a capacitor, the inductor being divided into two series-connected portions by a triggerable switch, together with connections for charging the capacitor symmetrically about a reference potential, and connections for applying the voltage waveform across the capacitor to the camera deflector plates, the connections including means for producing a phase displacement between the waveform applied to the shutter plates and that applied to the compensating plates. (UK)

16203 SIMPLE CRYOSTAT FOR NEUTRON DIFFRACTION. Sparks, Joseph T.; Komoto, T.; Wade, William R. (Univ. of California, Livermore). Contract W-7405-eng-48. Rev. Sci. Instrum., 38: 275-6(Feb. 1967). (UCRL-70063).

A simple, rugged, variable temperature cryostat with fast thermal response for powder neutron diffraction studies from about 70 to 800°K is described. It is used to overlap and extend upward the temperature range of a variable temperature cryostat which operates from 2 to 90°K with a liquid helium. (auth)

16204 AN INTEGRATED FAST CORRELATION UNIT FOR n = 4 BINARY VARIABLES. Prezzi, C.; Soso, F. (CNEN, Frascati, Italy). Nucl. Instrum. Methods, 68: 45-9(Feb. 1, 1969).

Correlation units are intended as flexible building blocks of decision electronics in multicounter experiments. The design and performance of a 4-variable module are reported. (auth)

16205 DETERMINATION OF ERRORS IN POLARIZED NEUTRON DIFFRACTOMETRY. Kendrick, H. (Univ. of Michigan, Ann Arbor); Werner, S. A.; Arrott, A. Nucl. Instrum. Methods, 68: 50-60(Feb. 1, 1969).

The polarized neutron method of determining the magnetic form factor of magnetic materials is examined in detail with special attention given to the way in which statistical errors are propagated. Because of the nonlinear relation between the polarizing efficiency of a crystal and the magnetic scattering length, the usual methods of linear error theory will not work. However, this difficulty can be circumvented by using the nonlinear formulas directly. The statistical error analysis is applied to the practical problem of how long one should count on a particular Bragg peak. This time will depend on the ratio of the magnetic to the nuclear scattering lengths, p/b, and on the accuracy with which the beam polarizations and flipping efficiencies have been determined. (auth)

16206 MULTIPARAMETER REGISTRATION SYSTEM DESIGNED FOR THE STUDY OF THREE BODY REACTIONS BY THE COINCIDENCE METHOD. Laugier, J. P.; Cadeau, M.; Fernier, P.; Laget, J. P.; Mouilhayrat, G.; Nicolas, P. (CEA, Bruyeres-le-Chatel, France). Nucl. Instrum. Methods, 68: 109-17(Feb. 1, 1969). (In French).

A multiparametric system has been developed for the study of three-body nuclear reactions. We have measured, for each nuclear event, the energy of the detected particles and the time of the detection. The time information is used to reduce the effective resolving time of the coincidence unit. The informations are recorded on a magnetic tape and at the same time partially treated with an on-line CAE 510 computer. The CAE 510 computer is used in delayed time to analyze the experimental data. (auth)

16207 DETERMINATION OF THE EFFICIENCY OF DOUBLE AND TRIPLE COINCIDENCE CIRCUITS AT A GIVEN RESOLUTION. Kalisz, J. (Institute of Nuclear Research, Swierk, Poland). Nucl. Instrum. Methods, 68: 179-80(Feb. 1, 1969).

A simple method is described, which allows the determination of coincidence-circuit efficiency at any given resolution or the determination of coincidence-circuit resolution at any given efficiency. Gaussian distributions of time spreads are assumed at the circuit inputs. (auth)

16208 DIRECT VOLTAGE CALIBRATION OF AN ELECTRON SPECTROMETER. Fadley, C. S.; Geoffroy, G. L.; Hagstroem, S. B. M.; Hollander, J. M. (Univ. of California, Berkeley). Nucl. Instrum. Methods, 68: 177-8(Feb. 1, 1969).

A calibration procedure for iron-free magnetic electron spectrometers is described. It involves the application of a known voltage to the electron source. This calibration technique yields the electron kinetic energy directly in eV. (auth)

16209 ACCURATE MEASUREMENT TECHNIQUES FOR NANOSECOND DELAYS AND TIME SCALE CALIBRATION. Taylor, H. E. (ORTEC, Inc., Oak Ridge, Tenn.). Nucl. Instrum. Methods, 68: 160-2(Feb. 1, 1969).

The practical use of two independent techniques which will measure nanosecond delays to an accuracy within 10 psec is described. The second technique is also useful for TPHC time scale calibrations. (auth)

16210 MICROPHONE SWITCH FOR CONTROLLING OF PNEUMATIC TUBE TRANSFER SYSTEMS IN NUCLEAR REACTORS. Dieck, L.; Sanner, L. (Kernforschungsanlage,

Juelich, Ger.). Nucl. Instrum. Methods, 68: 157-8(Feb. 1, 1969). (In German).

An in-pile indication by picking of the sound of the capsule of a pneumatic transfer system in a nuclear reactor hitting a stop collar is described. (auth)

16211 RC-SHAPED PULSE GENERATOR (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1834). 3 drawings.

A pulse generator used to check the differential linearity of pulse-height analyzers is described. A simple transistor chopper is used to replace the mercury-wetted relay which is usually employed. Repetition rates are up to 15 k Hz for regular pulses and 5 k Hz for random pulses. The pulse generator is simple, reliable, and economical and its linearity is good enough to test most nuclear systems. (For details see TID-4100 Suppl. 51.) (F.S.)

16212 MULTI UNIT PULSE GENERATOR (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1832). 6 drawings.

A general purpose pulse generator is described. It has four separate emitter-coupled monostable circuits, and each circuit can be triggered once by a pulse or a rising or falling edge or made to oscillate by applying a voltage level through a dc path. The resulting pulse length (or repetition rate) is set by plugging in capacitors. The four circuits can be interconnected inside the generator to provide pulse formers, delays, gates, or oscillators. Positive and negative outputs from each circuit are available on the front panel. Rise and fall times are typically 20 to 100 nsec depending on the load. The maximum oscillation frequency is ~5 M Hz. Two models are available. One uses a pnp transistor and the other an npn. (For details see TID-4100 Suppl. 51.) (F.S.)

Radiation Effects on Instruments and Instrument Components

16213 (CEA-CONF-1145) UNITARY SORTING AND DEPENDABILITY OF PLANAR TRANSISTORS UNDER IRRADIATION-RESTORATION CYCLES. Benbadis, Himcha; Ghirlanda, Jacques (Texas Instruments France, Villeneuve-Loubet); Blin, Andre; Le Ber, Jacques (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [1968]. 23p. (In French). (CONF-681118-1). Dep.

From International Symposium on Reliability of Electronic Components, Grenoble, France.

The effect of a unitary sorting on the behavior of transistors exposed to irradiation-restoration cycles and then to standardized stresses in order to show an eventual degradation of their stability for classical stresses was evaluated. The results of the experimental study showed a similarity of the behavior of the standard and high reliable lots of transistors; PNP transistors have, however, a higher tolerable dose. The irradiation-restoration cycles produce a unitary sorting which eliminates the marginal or doubtful elements. The stresses during the cycle do not degrade the reliability of the transistors. These elements are not more stable than the standard non-treated elements. A unitary selection procedure is proposed. (tr-auth)

16214 (N-68-25718) OPTICAL STUDIES ON THE LITHIUM DEFECT COMPLEX IN IRRADIATED SILICON. Progress Report, June 15, 1967-March 15, 1968. Corelli, John C. (Rensselaer Polytechnic Inst., Troy, N. Y. Div. of Nuclear Engineering and Science). Mar. 15, 1968. 30p. (NASA-CR-94916). CFSTI.

The lithium defect complex produced in silicon irradiated by 1.5 MeV and 45 to 50 MeV electrons was studied. The main probe used to detect the defects was the infrared spectroscopy of defect absorption bands that arise in the association of lithium atoms and vacancies and/or interstitials produced in displacement of silicon atoms by the radiation. During irradiation the temperature was maintained at ≤22°C. Subsequent to irradiation the infrared spectra (1 to 50 microns) were taken with the sample kept at 300°K and at ≈80°K. Isochronal annealing experiments using 15 minute pulses were conducted at temperatures up to ≈800°K. It is indicated that the most striking results of the study are that for high lithium doping concentrations, the lithium atoms apparently combine with other defects such as the divacancy and produce either a new complex of more constituents, or the Li atoms quickly combine with single vacancies (or multiple vacancies) and thereby immobilize the vacancies and prohibit them from exhibiting further motion in the lattice. (STAR)

16215 (N-68-32919) ACTION OF LITHIUM IN RADIATION HARDENED SILICON SOLAR CELLS. Quarterly Report, April 23-July 15, 1968. Brucker, G. J.; Faith, T. J.; Holmes-Siedle, A. G. (Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.). Aug. 15, 1968. Contracts NAS7-100; JPL-952249. 47p. (NASA-CR-96277; QR-1). CFSTI.

For Jet Propulsion Lab., Pasadena, Calif.

A report on a program to study and analyze the action of lithium in producing a recovery of radiation damage in silicon solar cells is presented. Technical progress during this reporting period includes stability data which are now available for some cells for periods ranging to approximately two years. The post-irradiation data, obtained after fluences of 10^{14}, 10^{15}, and 10^{16} e/cm^2, indicate that post-recovery redegradation is most severe after 10^{14} e/cm^2. After 10^{15} and 10^{16} e/cm^2, recovery is less complete but redegradation less severe. Over an 18-month period, redegradation phenomena in lithium-containing solar cells can vary from insignificant in magnitude to very serious. A definite superiority of Float-Zone-refined silicon over Lopex silicon is seen; the few samples tested indicate that Quartz-Crucible silicon, while producing a much slower recovery than the other two, shows minimal redegradation over 18 months. High lithium concentrations are definitely to be avoided. It appears that lattice damage is present in the junction depletion region even before irradiation and that this can be useful in stabilizing lithium in the cell. Hall and resistivity measurements indicate that carrier-removal rates at low temperatures are lower in lithium-doped silicon than in phosphorus-doped silicon, which also contains oxygen. (auth) (STAR)

16216 (N-68-33277) INVESTIGATION OF ELECTRON-RADIATION-INDUCED DIELECTRIC BREAKDOWNS IN A TYPICAL CAPACITOR METEOROID DETECTOR SYSTEM. Storti, George M.; Rambo, George E.; Hendricks, Herbert D.; Ballard, Thomas B. (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). Sept. 1968. 29p. (NASA-TN-D-4738). CFSTI.

The effects of electron radiation on capacitor-type detector systems similar to those used on the Pegasus satellite were investigated. Each system that was tested consisted of a polyurethane foam panel containing two capacitor-type-meteoroid detectors, several meters of polyethylene terephthalate insulated electrical leads, and other items such as rubber shock mounts and polyethylene terephthalate adhesive tape. Three different target thicknesses for the meteoroid detectors were tested, 40, 200, and 400 microns. The incident kinetic energy of electrons used in the tests ranged from 30 keV to 1000 keV, and the temperature of the detector systems was maintained at either 197 or 297°K. It was found that radiation-induced dielectric breakdowns were produced in the systems and that some of these signals were indicated as meteoroid penetrations. It was determined that the primary source of the breakdowns and, hence, the penetration indications was the polyethylene terephthalate insulated wire. The number of breakdowns and penetration indications obtained for a fluence of 5×10^{13} e/cm^2 was found to be dependent on the incident kinetic energy of the electrons and the system temperature; that is, more breakdowns and penetration indications occurred at the lower temperature (197°K) and the lower energies (30 to 100 keV). Tests were performed with different modifications made to the signal processing circuits. Several of these modifications resulted in a significant reduction or the total elimination of the radiation-induced penetration indications. Finally, it was found that those systems containing 200 and 400 micron detectors with 200- and 400-micron-thick targets suffered severe decreases in resistance in the capacitor-type detectors. (auth) (STAR)

16217 (N-68-33502) RADIATION DAMAGE IN LITHIUM-CONTAINING SOLAR CELLS. Final Report, June 21, 1966-March 20, 1968. Brucker, G.; Faith, T.; Holmes-Siedle, A. G.; Neadle, R. (Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.). Apr. 1968. Contract NAS5-10239. 111p. (NASA-CR-96368). CFSTI.

The interactions of lithium with defects induced in silicon solar cells by 1-MeV electron bombardment have been investigated. Solar cells used as test vehicles were supplied by NASA and test diodes similar to solar cells were made. The principal techniques used in the study to investigate the interaction of lithium with a radiation induced damage center were the capacitance method of measuring donor (lithium) concentration, the electron-voltaic method of measuring diffusion length, and the measurement of diffusion length vs excess carrier density. Recovery of solar cells appeared to follow a diffusion-limited kinetic model. Recovery theory was shown to correlate with measurements of lithium density profiles and direct measurements of the effective lithium-diffusion constant. The electric field arising from the ratio of donor-concentration gradient to donor concentration is, in some cases, sufficiently large to affect the collection of minority car-

riers. The effect of the electric field is particularly important when the diffusion length is reduced to a low value by electron bombardment; at that point the concept of a diffusion length begins to lose its physical meaning. (auth) (STAR)

16218 (SC-DC-68-2542) RADIATION TOLERANCE OF MOS DEVICES. Gwyn, C. W. (Sandia Labs., Albuquerque, N. Mex.). [1968]. 7p. (CONF-690309-2). Dep. CFSTI.

From IEEE International Convention and Exhibition, New York.

A previously held assumption that MOS transistors are less vulnerable to nuclear radiations is shown to be inaccurate. The radiation induced processes in MOS devices are discussed. Methods of obtaining hardened devices are examined. (B.G.D.)

16219 (SC-DC-69-1615A) DEFECT ANNEALING IN IRRADIATED DEVICES. Gregory, R. L.; Sander, H. H. (Sandia Labs., Albuquerque, N. Mex.). [nd]. 9p. (CONF-690309-1). Dep. CFSTI.

From IEEE International Convention and Exhibition, New York.

The primary defects produced when semiconductor materials and devices are exposed to electrons, gamma radiation, and fast neutrons are discussed. The defect reordering processes are also examined. (B.G.D.)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Refer also to abstracts 15816, 15890, 16256, 16276, 16277, 16291, 16302, 16304, 16332, 16354, 16384, 16435, and 16444.

16220 (AD-664176) EFFECT OF WHOLE-BODY IONIZING IRRADIATION ON ACTIVITY LEVELS OF BLOOD SERUM ENZYMES. Final Report, March 23, 1965-May 15, 1967. Weinstock, Albert; Hawrylewicz, E. J. (IIT Research Inst., Chicago, Ill.). Dec. 1967. Contract OCD-PS-64-200. 51p. (IITRI-L-6025-5; USNRDL-TRC-67-36). CFSTI.

The purpose of this study was to review the technical literature to obtain information on whether whole-body exposure of animals to ionizing radiation in the approximate LD50 range for man (300 to 600 rads) induces changes in the activities of specific blood serum enzymes that are dose-related and suitable as a basis for the development of a biological radiation dosimeter. Of the enzyme systems reviewed, lactic dehydrogenase (LDH) isoenzymes and cholinesterase appear to have the most promise. Values obtained for the ratio of LDH isoenzyme bands 1 : 2 showed that various levels of ionizing radiation, including the LD50 range for man, can be distinguished. At 24 hr after sham irradiation the relative ratio of bands 1 : 2 of normal (control) male rhesus (Macaca mulatta) monkeys was in the range of 1.0 to 2.5, whereas at 24 hr after 200 to 500 rads of gamma irradiation of monkeys the ratios ranged from 0.88 to 0.36. At radiation levels above 500 rads, the LDH isoenzyme response was further magnified. The serum cholinesterase activities of various species of animals exposed to whole-body ionizing persisted over a 2- to 3-day period. Although this observation was based on a relatively limited number of evaluations, the response was consistent. (auth) (USGRDR)

16221 (AD-668164) METHODS FOR STUDYING THE TIME COURSE OF CELL DIVISION IN CLONES FROM INDIVIDUAL L5178Y LEUKEMIA CELLS. Nachtwey, D. Stuart; Kendall, Kathleen; Holloway, Roy J. (Naval Radiological Defense Lab., San Francisco, Calif.). Feb. 27, 1968. 21p. (USNRDL-TR-68-30). CFSTI.

A step-by-step procedure is given for embedding L5178Y cells in fibrin gels so that individual cells may be observed repeatedly from their initial single state up to the formation of a colony. (The method is a modification and extension of the method of Schindler). An experimental example of the types of information obtainable is presented. (auth) (USGRDR)

16222 (MIT-952-5(Pt.2), pp S.1-23) RADIUM AND MESOTHORIUM TOXICITY IN HUMAN BEINGS. (Massachusetts Inst. of Tech., Cambridge. Dept. of Physics).

Measurements were made of the radioactivity caused by the presence of Rn, ^{214}Pb, or ^{214}Bi in the breath of human patients with body burdens of ^{226}Ra ranging from 0.02 μCi to 2 μCi. Data on 20 subjects were analyzed and compared with results of whole-body γ measurements in an effort to determine Ra and Rn retention parameters. Thick source spectroscopy was used to study the distribution of ^{226}Ra and ^{210}Po in skull bone pieces from patients with body burdens of ^{226}Ra. Whole bones were also analyzed for ^{226}Ra and ^{207}Pb in an effort to determine macroscopic variations in the skeletal distribution of these radionuclides in humans with body burdens of ^{226}Ra as a function of age and time since exposure. Osteometric data are included for the skeletons of 18 females. Bone sections and microradiographs of bones were examined for evidence of the hypermineralization of Haversian canals in bones from radium cases. (C.H.)

16223 (NIRS-7) ANNUAL REPORT [ON RADIOLOGICAL SCIENCES], 1967. (National Inst. of Radiological Sciences, Chiba (Japan)). Oct. 1968. 16p. Dep.

Separate abstracts were prepared for seven sections of this report. A list of approximately 150 publications by staff members issued between April 1, 1967, and March 31, 1968, is appended. (H.L.W.)

For abstracts of individual sections see: 16180, 16224, 16225, 16256, 16257, 16332, and 17302.

16224 (NIRS-7, pp 21-35) BIOCHEMISTRY AND BIOPHYSICS. (National Inst. of Radiological Sciences, Chiba (Japan)).

Studies on Escherichia coli showed that when bacteria were submitted to analysis by centrifugation immediately after x radiation with 7.5 kR, DNA of lower molecular weights appeared in both rec$^-$ and rec$^+$ strains. When the irradiated bacteria were incubated 30 min before analysis, the low molecular weight DNA disappeared from the sedimentation profile of rec$^+$ but not from that of rec$^-$. Investigations were made on kinetics of degradation of Escherichia coli K 12 rec$^-$ after irradiation with ultraviolet light. Studies were conducted on photosensitized modification of bovine pancreatic ribonuclease by a colored substrate analogue, 4-thiouridine-2'(3')-phosphate. Radioinduced dissociation of thymic deoxyribonucleoprotein in relation to cellular age was investigated using thymic lymphocytes. Effects of p-arsanilic acid on x-radioinduced dissociation of deoxyribonucleoprotein in thymus were studied. Studies on activation of myosin-ATPase by x-irradiated histidine included isolation and characterization of the activation agent formed from histidine on irradiation and determination of the activation mechanism. Effects of γ radiation on amylase synthesis in the rat pancreas in vitro were studied. Inhibitory effects of γ radiation on oxidative phosphorylation in mitochondria were studied. Chromosome aberrations and mitotic death in x-irradiated HeLa cells were investigated. Biological standards of comparison for the evaluation of a radioprotective agent based on survival analysis in experimental animals are discussed. Effects of ionizing radiation on passive transport of the sodium ion into human erythrocytes were investigated. Carbon-14-labeled isomerase was used in studies on the mechanism of induction of an adaptive enzyme in Pseudomonas testosteroni. Steroid biosynthesis in vitro by a transplantable interstitial cell tumor of mice was studied. Effects of x radiation on glycolysis in rat thymocytes were investigated. (H.L.W.)

16225 (NIRS-7, pp 36-55) PHYSIOLOGY. (National Inst. of Radiological Sciences, Chiba (Japan)).

Studies were conducted on kinetics of recovery from injury after whole-body x-irradiation of the fish, Oryzias latipes, at different temperatures. Effects of temperature on the rate of spermatogenesis in fish were studied using autoradiographic techniques. A study was made of the incorporation of ^{3}H-thymidine into hematopoietic cells of goldfish during recovery from radiation injury. Effects of fractionated whole-body x-irradiation on cell proliferation in the intestinal epithelium of goldfish were analyzed using autoradiography. Studies were conducted on effects of x radiation on DNA synthesis and cell proliferation in the intestinal epithelial cells of the goldfish at different temperatures. Effects of ionizing radiation on cultured mouse leukemic cells were studied. Investigations were conducted on effects of whole-body x radiation on nuclear RNA polymerase activities in rat tissues. The immunofluorescent antibody technique was used in cytogenetic studies on Friend tumor cells. Hematopoiesis was induced in the thymus by injection of microsomes of thymus from sensitized animals. Antihemorrhagic effects of thrombocyte transfusion on the number and serotonin content of thrombocytes x-irradiated were studied. Modification of radiosensitivity by antithrombocyte serum injection in mice was investigated. A quantitative histologic analysis of hematopoietic tissues in two strains of x-irradiated mice was made. In vitro studies were conducted on ^{59}Fe uptake by x-irradiated mouse red blood cells. The possibility of double tracer studies in whole-body radioautography using color was studied. Effects of serotonin on intestinal mobility of x-irradiated rabbits and mice were studied. The radioprotective mechanism of serotonin was studied using macroautoradiography. Effects of ionizing radiation on hematopoietic stem cell recovery were investigated. Effects of bone marrow transplants on x-radiosensitivity of erythroid cells in various maturation stages were studied. Antibody formation by transferred spleen cells was studied in mice given lethal doses of x radiation. (H.L.W.)

16226 (ORO-3799-1) SPIN INTERACTIONS BETWEEN SLOW ELECTRONS AND AMINO ACID FILMS. Progress Report I, June 1, 1968-February 28, 1969. Yeargers, Edward (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Mar. 1, 1969. Contract AT(40-1)-3799. 6p. Dep. CFSTI.

The status of a research program on the nature of the excited states produced by slow electrons incident on amino acid films is described. The program was begun in June 1968; since that time the design and construction of the experimental apparatus has been almost completed and a set of semiempirical, self-consistent-field calculations have been made for tryptophan. The latter calculations were made to determine the locations of the singlet and triplet levels which subsequently will be investigated with the newly constructed experimental apparatus. In addition to energy level calculations, charge densities, bond lengths, and static and transition

dipole moment magnitudes and directions were computed for the various transitions. A quantum mechanical description of the interaction between the spin of an incident electron and the orbital motion of an atomic electron was begun. (auth)

16227 EFFECT OF A TOTAL γ-IRRADIATION ON THE TISSULAR PROTEINS SYNTHESIS. Ivanov, I. I.; Rudakov, V. V. (Kirov Military Medical Academy, USSR). Byull. Eksp. Biol. Med., 66: No. 12, 47-9(Dec. 1968). (In Russian).

Glycine-^{14}C incorporation in water-soluble mammary tissue proteins of lactating rats under normal conditions and at various periods after a total γ-irradiation in doses of 600 to 5000 R was studied. The radioactivity of tissular proteins in the first hours after irradiation even with high doses (5000 R) was found not to differ from that in nonirradiated animals. At the same time later in the course of the radiation sickness one could see an abrupt decline of the glycine-^{14}C incorporation in the water-soluble proteins of a lactating mammary gland even under the effect of ionizing radiation of much smaller doses (600 to 900 R). In the terminal period of radiation sickness the incorporation of a radioactive label was almost entirely suppressed. The present research bears witness to the absence of any direct action of the ionizing radiation upon the protein-synthetizing systems. (auth)

16228 VITAMIN B_6 EFFECT UPON THE ^{59}Fe UTILIZATION BY PRONORMOBLASTS AND NORMOBLASTS OF PATIENTS WITH IRON DEFICIENCY ANEMIAS. Kanaev, S. V.; Shcherban, E. I.; Shostka, G. D.; Lapotnikov, V. A. (Medical Inst., Leningrad). Byull. Eksp. Biol. Med., 66: No. 12, 31-3(Dec. 1968). (In Russian).

Microautoradiography was used in studies on marrow brain cultures of patients with iron deficiency anemia. A stimulating effect of vitamin B_6 on erythropoiesis was observed; this was manifested by an increased iron-59 uptake by erythroid cells. (auth)

16229 NUCLEIC ACID CONTENT IN THE EMBRYONIC LIVER AND UPTAKE OF ^{32}P BY THE LIVER RNA AFTER STIMULATION OF THE LIVER GROWTH BY HUMORAL FACTORS. Konyshev, V. A. (Inst. of Experimental Biology, Moscow). Byull. Eksp. Biol. Med., 66: No. 12, 53-4(Dec. 1968). (In Russian).

Plasma albumin from a cock and man when injected into chick embryos accelerates the growth of the liver. The content of nucleic acids in the liver does not rise, which differentiates this process from regeneration hypertrophy of the liver, but the uptake of ^{32}P RNA is increased. Laurinic and bilirubin complexes of the egg albumin show a tendency to an increased uptake of ^{32}P by RNA. The above data contradict the hypothesis on the role of blood albumin as an inhibitor of the growth of the liver. (auth)

16230 OPTIMAL DOSES OF ^{32}P FOR ISOTOPE LABELING OF THE COMMON VOLE. Litvin, V. Yu. (Inst. of Epidemiology and Microbiology, Moscow). Zool. Zh., 46: 1088-93(1967). (In Russian).

Different doses of ^{32}P were tested to establish the optimal dose for isotope labeling of the common vole (Microtus) in nature. Doses of 0.5, 1, and 2 mCi led to the death of the animals. Doses of 0.0625, 0.125, and 0.25 mCi did not cause apparent pathologies in the animals. With a dose of 0.25 mCi, single portions of urine voided by the common vole in natural conditions 1 to 4 days after the phosphorus injection were found to possess a safe level of radioactivity. The doses of ^{32}P for isotope labeling of the common vole in nature should not exceed 0.25 mCi. (auth) (ATD)

16231 EFFECTS OF ACTH AND WHOLE-BODY X-IRRADIATION ON THE CONCENTRATIONS OF ENZYMES, NICOTINAMIDE NUCLEOTIDES, AND CYTOCHROMES IN RAT-ADRENAL. Yago, Nagasumi; Omata, Saburo (National Inst. of Radiological Sciences, Chiba, Japan). J. Biochem. (Tokyo), 62: 339-44(Sept. 1967).

The levels of DNA, RNA, protein, nicotinamide nucleotides, enzymes and cytochromes P-450 and b_5 in rat adrenals were determined 24 hours after a single injection of ACTH (10 units) and 24, 48, and 72 hours after whole-body x-irradiation at a lethal dose (1000 R). At these times, adrenal nuclei showed abnormally high RNA polymerase activity. The concentrations of nicotinamide nucleotides did not change during the experimental periods. In mitochondria, succinate dehydrogenase [EC 1.3.99.1] increased rather abruptly 72 hours after x-irradiation, while $NADH_2$ cytochrome c reductase decreased significantly during the experimental periods. P-450 was increased after 24 hours but was significantly decreased after 48 and 72 hours. $NADPH_2$ cytochrome c reductase remained unchanged after 24 and 48 hours but had decreased after 72 hours. In microsomes, cytochrome b_5 and $NADH_2$ cytochrome c reductase decreased significantly after ACTH and x-irradiation. P-450 and $NADPH_2$ cytochrome c reductase remained at the control levels, with a temporary increase of the former 24 hours after x-irradiation. (NSA of Japan)

16232 REMOVAL OF RADIONUCLIDES AT DIFFERENT MULTIPLICATION PHASES OF MARINE BACTERIA. Seki, Humitake; Taga, Nobuo (Tokyo Univ.). Nippon Kaiyo Gakkaishi, 23: 136-40(June 1967).

Removal of radionuclides in marine Vibrio species was examined at different phases of the bacterial multiplication, namely, during the non-clumping phase when removal is considered to be mainly caused by uptake and firm adsorption, and during the clumping phase when removal is by trapping. Concentration factors in the bacteria at different phases of multiplication for each nuclide are as follows: ^{141}Ce, 967-8114; ^{137}Cs, 0.8-68.7; ^{65}Zn, 90-164; ^{45}Ca, 0.2-10.4. (NSA of Japan)

16233 DETERMINATION OF ^{14}C AND SIMULTANEOUS DETERMINATION OF ^{3}H AND ^{14}C IN BIOLOGICAL MATERIALS BY LIQUID SCINTILLATION COUNTER. Baba, Shigeo (Tokyo Coll. of Pharmacy); Iwahara, Shigetoshi. Yakugaku Zasshi, 88: 635-8(May 1968). (In Japanese).

Methods were examined for measuring ^{14}C and for simultaneous measuring of ^{3}H and ^{14}C in biological samples. A lyophilized organ material was pulverized and about 20 mg of the powder was burnt in an oxygen flask. A scintillator containing ethanolamine was used for radioactive carbon dioxide and a scintillator containing dioxan and ethanolamine was used for simultaneous measurement of ^{3}H and ^{14}C. Recovery of ^{14}C was 96.3% and its standard deviation was 1.4%. Reproducibility of the assay was further examined with the liver of a rat given ^{14}C-ephedrine with satisfactory results, i.e., the standard deviation was 0.8%. Recoveries of ^{3}H and ^{14}C were 99.8 and 99.3%, respectively, in the simultaneous measurement, and their standard deviation was 1.3 and 1.5%. (NSA of Japan)

16234 SYNTHESIS OF FUNCTIONAL PROTEINS IN X-IRRADIATED MAMMALIAN CELLS. Tobey, R. A.; Petersen, D. F.; Walters, R. A. (Los Alamos Scientific Lab., N. Mex.). Nature (London), 221: 191(Jan. 11, 1969).

Recovery from x-ray induced division delay in Chinese hamster cells cultured in vitro was found to require protein synthesis, but not synthesis of DNA or RNA, suggesting that the primary lesion is at the level of translation. The question arises whether or not normal proteins are synthesized during the recovery period. The ability of a cell recovering from radiation damage to support synthesis of functional proteins may be established by introducing into the intact irradiated cell an alien messenger species and determining whether or not the cellular synthetic mechanism can support synthesis of the corresponding functional non-cellular protein. This was studied by infecting x-irradiated (600 R) hamster cells with the RNA virus mengovirus and determining the time course of production of infective virus particles. The infecting viral genome was the alien messenger species, and only particles with normal protein coats, indicating synthesis of functional protein, were able to infect cells and initiate plaque formation in the infectivity assay. Results obtained indicated that virus production proceeds normally in cells recovering from radiation damage. (UK)

16235 TECHNIQUE FOR SELECTIVELY MARKING AQUATIC INSECTS WITH ^{32}P. Bishop, J. E.; Bishop, J. B. (Univ. of Waterloo, Ont.). Limnol. Oceanogr., 13: 722-4(Oct. 1968).

The technique and apparatus used for selectively marking aquatic insects with ^{32}P are described. The method allowed for tagging of individual lymphs, allowed single, labeled insects to be detected live, and did not contaminate the biotope. Long-term effects of the radiation on the insects were not determined. (C.O.)

16236 TAGGING NATIVE GRASSLAND VEGETATION WITH ^{14}C. Dahlman, Roger C. (Oak Ridge National Lab., Tenn.); Kucera, Clair L. Ecology, 49: 1199-1203(Autumn 1968).

Techniques using a plastic tent to contain $^{14}CO_2$ gas over herbaceous vegetation were effective for applying a tracer to a Missouri tallgrass prairie. Ten separate areas, measuring 1.98 by 3.35 m and containing a mixed stand of big bluestem (Andropogon Gerardi), little bluestem (A. scoparius), Indian grass (Sorghastrum nutans), and prairie dropseed (Sporobolis heterolepis), were simultaneously exposed to $^{14}CO_2$ under full sunlight. The grasses incorporated 67 to 41 μCi of $^{14}C/m^2$ from a single exposure to 151 μCi of $^{14}CO_2/m^2$ for 6 hr on clipped and unclipped areas, respectively. Regenerated shoots, which had been clipped 6 weeks earlier, possessed 8 times higher specific activity than unclipped shoots (0.134 vs. 0.017 μCi/g of carbon in foliage biomass). The root systems of both areas possessed over 50% and

the roots of mature vegetation as much as 85% of the assimilated ^{14}C remaining in the plant biomass 8 weeks after tagging, thus illustrating the tendency for food reserves to accumulate in underground storage organs late in the growing season. Specific activities in the root system were similar (0.02 vs. 0.016 μCi/g C) for both revegetated and mature areas and were adequate for study of later translocation, transfer to soil, and in situ decomposition of organic material in soil. (C.H.)

16237 CALCIUM–STRONTIUM METABOLISM IN WHITE TAILED DEER AS RELATED TO AGE AND ANTLER GROWTH. Cowan, R. L.; Hartsook, E. W.; Whelan, J. B. (Pennsylvania State Univ., University Park). Proc. Soc. Exp. Biol. Med., 129: 733-7(Dec. 1968).

The ^{45}Ca and ^{89}Sr deposited in the skeletons of calcium-depleted yearling and 2-year-old male deer prior to initiation of antler growth were mobilized and transported to the antlers, as indicated by activity measured in the antlers at sacrifice 62 days after dosing. Retention of both ^{45}Ca and ^{89}Sr in skeletal samples, and also transfer to antlers, was highest in the younger deer. Younger deer also exhibited less discrimination against uptake of strontium relative to calcium, as shown by higher $OR_{sample/dose}$ values for most skeletal samples. Cumulative fecal excretion of both isotopes was also higher in the younger animals, and calcium was excreted at a higher rate than strontium in both yearling and 2-year-old. (auth)

16238 EFFECT OF REGIONAL SHIELDING ON PLASMA ENZYME CHANGES IN RATS AFTER 800 R X-IRRADIATION. Highman, Benjamin; Stout, David A.; Hanks, Alan R. (Armed Forces Inst. of Pathology, Washington, D. C. National Inst. of Health, Bethesda, Md. National Center for Radiological Health, Rockville, Md.). Proc. Soc. Exp. Biol. Med., 129: 857-60(Dec. 1968).

Groups of unshielded and regionally shielded rats were exposed to 800 R x irradiation and compared with nonirradiated controls. As reported in an earlier study, unshielded rats showed a moderate rise in plasma glutamic oxalacetic transaminase (PGOT) at 6 hr and a marked fall in plasma alkaline phosphatase (PAkP) at 4 days after irradiation. Shielding the abdomen prevented or greatly lessened these changes. Irradiating only the abdomen produced a relatively moderate rise in PGOT at 6 hr but caused a marked fall in PAkP at 4 days after irradiation comparable to that found after whole-body x irradiation. It is suggested that the rise in PGOT is derived in part from excess GOT released from overtly damaged lymphoid and other radiosensitive tissues and in part from other tissues due to a widespread initial increase in cellular permeability induced by X-irradiation. The fall in PAkP is attributed to a reduced contribution of intestinal AkP to the circulation due to radiation injury to the intestinal mucosa. (auth)

16239 DOSE STUDY OF ^{32}P INCORPORATION INTO THE NUCLEIC ACIDS OF RAT LYMPHOID TISSUES. Pierce, James C. (Medical Coll. of Virginia, Richmond). Proc. Soc. Exp. Biol. Med., 129: 910-12(Dec. 1968).

There was linear incorporation of doses of ^{32}P ranging from 0.191 to 1.91 μCi/g of body weight into DNA, RNA, and the acid soluble phosphorus fraction of the lymph nodes and thymus in rats at 4 and 48 hr after injection. The intercepts of the regression lines of these dose-incorporation curves extrapolated to 0 dose did not differ significantly from 0. These observations indicated that intraperitoneal doses of ^{32}P up to 1.91 μCi/g of body weight did not significantly modify the rate of DNA or RNA synthesis in the lymphoid tissues of rats. There was, however, a highly significant depression of DNA synthesis in the thymus, but not in the lymph nodes 48 hr after the intraperitoneal injection of 9.5 μCi of ^{32}P/g of body weight. It is concluded that doses of ^{32}P up to 1.9 μCi/g of body weight may be used to study nucleic acid synthesis for time intervals up to 48 hr in the lymphoid tissues of rats. (auth)

16240 COMPOUND-PHOSPHOLIPIDS FORMED IN VIVO BY IRRADIATION. PART 2. EFFECTS OF PHOSPHOLIPIDS (EXTRACTED IN VIVO AFTER IRRADIATION) ON THE CULTURE CELLS OF EHRLICH TUMOR (JTC-11). Aono, Kaname (Okayama Univ., Japan). Okayama Igakkai Zasshi, 80: 453-9(Apr. 1968). (In Japanese).

The compound-phospholipids extracted from tissues of the rabbits exposed to total body irradiation possess hemolytic and cytolytic effects similar to the effects of irradiation itself. In view of this, the present experiment was conducted in order to observe what effects such an extract would have on the growth of Ehrlich tumor culture cells (JTC 11, strain maintained in the laboratory of Cancer Institute, Okayama Univ.). These cells were cultured in the media containing the aforementioned phospholipids extract in the concentration of 0.1% or 0.5%, and for the control the phospholipids extracted from non-irradiated rabbits was added to the medium in the same concentration. The percentage of degeneration of Ehrlich tumor cells was calculated at intervals of one, 3, and 6 hours after the addition of the extract. Two days after the start of culture, the extract was added to the medium, and its effect on the proliferation of Ehrlich cells was studied on the fourth day of the addition of extract. Similarly, morphological changes of Ehrlich cells were observed by electron microscopy at the intervals of 3, 12, 24, and 48 hours after the addition of the extract. As a result it was found that the phospholipids substance extracted from the irradiated rabbit showed a greater degenerative effect and stronger inhibition on the culture cells as well as it elicited more marked morphological changes than the extract from non-irradiated rabbit. From this, it is obvious that the extract of the irradiated rabbit has the ability to inhibit the cell growth and destroy the cells which is similar to the disturbances brought about by irradiation. (auth)

16241 A CHARACTERISTIC DIFFERENCE OF RADIOSENSITIVITY BETWEEN PHAGE CONTAINING SINGLE- AND DOUBLE-STRANDED NUCLEIC ACID. Hotz, Gerhart (Kernforschungszentrum, Karlsruhe, Ger.). Mol. Gen. Genet., 102: 364-66 (1968).

A study was made to determine if the amount of radiation damage to DNA that occurs in the water layer surrounding the molecule is dependent on the structure of the molecule (single- or double-strandedness), DNA from several phages were γ and x irradiated in the presence and absence of glycerol. Results showed that relatively high concentrations of glycerol were necessary for appreciable radioprotection. After reaching a maximum of protection, sensitization by high concentrations of glycerol was observed. Only phage strains containing double-stranded DNA were protected. Phage containing single-stranded DNA or RNA did not show this effect. It was proposed that the radioprotective action of glycerol was on the nucleic acid of the bacteriophage. Transfer of the damaging radiation energy was blocked when water molecules were replaced by the glycerol. (C.O.)

16242 STUDIES ON INCORPORATION OF RADIOSULPHATE IN THE GASTRIC MUCOSA OF THE RAT. Leonard, J. P.; Andre, C.; Martin, F.; Martin, M. S.; Lambert, R. (Faculte de Medecine, Lyon). Compt. Rend. Soc. Biol., 162: 910-14(Nov. 23, 1968). (In French).

The level of radiosulfate in the plasma and its incorporation into the gastric mucosa were measured as a function of time 24 hrs after a single injection of 100 microcuries of sulfur-35-labeled sodium sulfate. In the plasma, the decrease occurs in two stages: an initial, rapid exponential stage, and a later slow stage. In the gastric mucosa the incorporated radiosulfate appears very early, within 30 min, and attains a maximum level within 3 hr; its decrease is relatively rapid. These results confirm histoautoradiographic data. (tr-auth)

16243 UPTAKE OF ^{131}I BY RAT TESTIS AND ITS DISTRIBUTION. Roy, S. K.; Pande, J. K.; Kar, Amiya B.; Dasgupta, P. R. (Central Drug Research Inst., Lucknow, India). Indian J. Exp. Biol., 7: 48-9(Jan. 1969).

Following a single subcutaneous injection of Na ^{131}I (20 μC), ^{131}I was demonstrated in serum, intertubular fluid and the seminiferous tubules of rats up to 48 hr. The possibility of protein binding of ^{131}I in the testis, and the entry of subtrate-rich intertubular fluid into the tubules is discussed. (auth)

16244 STUDIES ON THE MECHANISM OF REJECTION OF TOLERATED SKIN HOMOGRAFTS AND ABROGATION OF IMMUNOLOGICAL TOLERANCE BY HYPERIMMUNE SERUM. Hasek, M.; Skamene, E.; Karakoz, I.; Chutna, Jitka; Nouza, K.; Bubenik, J.; Sovova, Vlasta; Nemec, M.; Jonak, J. (Inst. of Experimental Biology and Genetics, Prague). Folia Biol. (Prague), 14: 411-24(1968).

The mechanism of rejection of tolerated skin homografts in ducks and abrogation of immunological tolerance after injection of humoral antibodies directed against isoantigens of the graft was studied. Experiments on the characterization of antibodies responsible for rejection of tolerated grafts showed that the reactivity is localized in the IgG (7S) fraction. The cytophilic nature of antibody was demonstrated by destroying the in vivo effect of serum after its absorption with isologous spleen cells. The cytotoxin titre was in no correlation with the in vivo effect of serum on the graft and the titre did not change even when cytophilic antibodies were absorbed. In the early phase after injection of serum the histological picture of the tolerated grafts undergoing rejection has all the characteristics of an Arthus reaction accompanied by polymorphonuclear infiltration. In the later phases lymphocytes are present within and outside

the vessels of the sloughing graft. Incidence of individual cell types during the rejection process and the significance of complement for graft rejection was studied. Induction of leucopenia by glucocorticoids or nitrogen mustard suppressed the Arthus-like reaction in most cases, while the grafts survived. X-irradiation and duck heterologous antilymphocyte serum affecting mainly lymphocytes reduced the Arthus-like reaction and completely prevented the skin graft rejection. Decomplementation of the organism using phosphomannan had similar effects. The interpretation of these findings is discussed with respect to the possible mechanisms of rejection of the tolerated grafts and loss of immunological tolerance. (auth)

16245 INHIBITORY EFFECT OF IMMUNE SERUM ON CARCINOGENESIS IN MICE NEONATALLY INFECTED WITH MURINE SARCOMA VIRUS (HARVEY). Bubenik, J.; Turano, A. (Univ., Parma, Italy). Folia Biol. (Prague), 14: 433-9(1968).

Two immune sera were prepared by immunization of inbred mice with irradiated tissue of tumours induced by murine sarcoma virus (MSV Harvey). Passive transfer of these sera had been previously found to enhance growth of small grafts of MSV-induced tumours in adult syngeneic recipients. Both sera contained antibodies capable of neutralizing the MSV (Harvey). They were not cytotoxic if allowed to react with cells of MSV-induced sarcomas, but gave positive results if examined by indirect immunofluorescence. Repeated injections of these sera into mice inoculated at birth with concentrated MSV (Harvey) could inhibit MSV carcinogenesis, even if started 1, 3 or 5 days after virus inoculation. The possible interpretation of the experimental data is discussed. (auth)

16246 STUDIES ON DEPOSITION OF ^{90}Sr ON TEETH. Suzuki, Shigetaka. Nippon Dent. Coll. Annu. Publ., 3: 47-9(Sept. 1966).

Whether the deposition of ^{90}Sr on teeth was accelerated by fluorine which was used for caries prevention and whether its deposition was inhibited by vitamin D or parathyroid hormone preparation were studied on rats. The results obtained were as follows: (1) When ^{90}Sr was mixed with enamel powder in vitro in the presence of fluorine, ^{90}Sr was rapidly deposited on enamel substance until around the 5th day after mixture, but was not deposited notably thereafter. (2) In rats administered 5 mg or 10 mg of NaF, ^{90}Sr deposited at a rate 1.0-1.5 times as quickly as in control rats and the degree of its deposition was less on the lower jaw than on the upper jaw. (3) In rats administered vitamin D in large quantities, front teeth of the upper and lower jaws showed little change in ^{90}Sr deposition. However, on molars, a little inhibition of deposition was observed. When administered in small quantities, the front teeth of upper and lower jaws showed larger deposition than those of the control group, while on molars, deposition inhibition was observed. (4) In rats given a large quantity of parathyroid hormone, front teeth of upper jaw showed reduced deposition of ^{90}Sr, 50% that of the control group in 150 units. No change was seen on their molars. With small quantities, the front teeth showed increased deposition, while molars showed a decreasing trend, and especially on molars of the lower jaw, deposition at about 50% of that of the control group was observed. (NSA of Japan)(TSS)

16247 ABSORPTION OF A MODEL FISSION PRODUCT MIXTURE FROM SKIN, BURNS, AND WOUNDS. Benes, Antonin. Voj. Zdravot. Listy, 37: No. 2, 52-4(Apr. 1968). (In Czech).

Absorption rates of model fission products containing ^{89}Sr, ^{32}P, ^{137}Cs, and ^{131}I were investigated on rats; absorption through intact skin, through second and third degree burns, and from muscle wounds was studied. The slowest rate of absorption occurs from the intact skin, it is faster from the burns, and fastest through muscle wounds. Each of the radioisotopes has its own absorption dynamics. From third degree burns the absorption is faster than from second degree burns; only ^{131}I and ^{137}Cs are really absorbed fast. ^{137}Cs showed the highest absorption rate. (JPRS)

16248 AUTORADIOGRAPHIC TECHNIQUES. LOCALIZATION OF RADIOISOTOPES IN BIOLOGICAL MATERIAL. Gude, William D. Biological Techniques Series. Englewood Cliffs, N. J., Prentice-Hall, Inc., 1968. 126p.

The treatment of autoradiographic techniques is especially designed for persons working with living organisms. Stress is placed upon methods that will consistently produce satisfactory autoradiograms. A brief history of autoradiography and its principles is given, including material on safety factors, theory, and detection of radioactivity. Materials and methods are discussed in relation to artifacts, electron microscopy, emulsion types, fixation, and preparation of smears. One chapter is devoted to experiments for demonstrating autoradiographic techniques. (C.O.)

16249 MOLECULAR MECHANISM OF RECOMBINATION IN BACILLUS SUBTILIS TRANSFORMATION. Bodmer, Walter F.; Laird, Charles D. (Stanford Univ., Palo Alto, Calif.). pp 184-205 of Replication and Recombination of Genetic Material. Peacock, W. J. (ed.). Canberra, Australia, Australian Academy of Science, 1968.

From International Conference on Replication and Recombination of Genetic Material, Canberra, Australia. See CONF-670822.

Evidence for physical integration of donor DNA in Bacillus subtilis and other transformation systems is reviewed. Estimates of the size of the integrated region are also reviewed. Then, evidence concerning DNA synthesis before, during, and after transformation, and the possible involvement of repair DNA synthesis is discussed. Recent experiments on the early stages of DNA uptake are described; genetic markers, radioisotope labels, and radioisotope density labels were used in donor and recipient cells. The existence of an initial, partially DNAase sensitive, stage of attachment of donor DNA to the recipient cell was verified. (C.O.)

16250 CHIASMATA AND CROSSING-OVER. Peacock, W. J. (Commonwealth Scientific and Industrial Research Organization, Canberra, Australia). pp 242-52 of Replication and Recombination of Genetic Material. Peacock, W. J. (ed.). Canberra, Australia, Australian Academy of Science, 1968.

From International Conference on Replication and Recombination of Genetic Material, Canberra, Australia. See CONF-670822.

Experiments were designed to determine the time at which crossover occurred in the meiotic cycle and to gain information on the mechanism involved in this form of recombination in higher animals. Spermatocytes of a grasshopper, Goniaea autralasiae, were used as the experimental system. The time of crossover was studied by inducing a change in chiasma frequency using temperature shock; DNA replication was followed by incorporation of ^{3}H-labeled-thymidine. It was shown that a high temperature shock applied at the early pachytene stage of meiosis grossly reduced the probability of a crossover event indicating that crossover occurred at early pachytene. Isotope labeling patterns were used to develop an argument to explain the relation of chiasmata to crossover. Homologous chromosomes that were not associated by a chiasma at metaphase I did not show any evidence in label pattern of having been involved in any crossover event. A statement as to the mechanism of crossover in higher organisms is made. (C.O.)

16251 THE BACILLUS SUBTILIS GENOME: STUDIES ON ITS SIZE AND STRUCTURE. Dennis, Elizabeth S.; Wake, R. G. (Univ. of Sydney). pp 61-70 of Replication and Recombination of Genetic Material. Peacock, W. J. (ed.). Canberra, Australia, Australian Academy of Science, 1968.

From International Conference on Replication and Recombination of Genetic Material, Canberra, Australia. See CONF-670822.

The physical structure of the genome of Bacillus subtilis was investigated. A relatively precise estimate of the size of the genome in terms of DNA content was found to be 5.4×10^{-15} g DNA/spore (3.3×10^{9} daltons). Maximal lengths of the genome were measured using autoradiographic techniques (^{3}H-labeled-thymine) in order to pursue the possibility that the amount of DNA present was as a single chromosome. It was shown that at least 70% of the genome existed as a single structure and most probably as a continuous piece of double-stranded DNA. In addition, autoradiographs of chromosomes obtained from B. subtilis labeled with ^{3}H-thymine for 2 to 3 generations suggested circularity of the replicating chromosome since possible initiation and replication loop regions were clearly observed. (C.O.)

16252 ANTIGENIC CHARACTERISTICS OF LYMPHOMAS INDUCED BY RADIATION LEUKEMIA VIRUS (RADLV) IN MICE AND RATS. Ferrer, Jorge F.; Kaplan, Henry S. (Stanford Univ., Palo Alto, Calif.). Cancer Res., 28: 2522-8(Dec. 1968).

Injection of radiation leukemia virus (RadLV) into newborn W/Fu inbred rats results in a high incidence of lymphomas indistinguishable from those induced by this virus in mice. Plasma from rats with primary RadLV-induced lymphomas exhibited a host range of leukemogenic activity in mice similar to that of mouse-derived RadLV. The antigenicity of the rat RadLV-induced lymphomas is indicated by their transplantation behavior and by their ability to induce the production of cytotoxic antibodies. These tumors cannot be transplanted into adult syngeneic rats unless these hosts are pretreated with doses of x rays known to depress the immune response. The serum of W/Fu adult rats immunized with syngeneic RadLV lymphomas is specifically cytotoxic for all of the rat and most of the mouse tumors induced by RadLV. The cytotoxicity of the rat antiserum is strongly absorbed by rat and mouse RadLV-induced lymphomas. Rat anti-RadLV sera also exhibit virus-neutralizing activity, as measured by inhibition of the leukemogenic

activity of RadLV in mice. Cytotoxic and absorption tests performed with specific rat antisera show complete cross-reactivity between RadLV and Gross lymphoma antigens. In addition, rat and mouse RadLV-induced lymphomas absorb the specific cytotoxicity of mouse anti-Gross serum. These data demonstrate that RadLV and Gross viruses induce identical or very closely related antigens in the transformed cells. The presence of the RadLV cell-associated antigen in most radiation-induced mouse lymphomas supports the view that RadLV may be an etiologic factor in these tumors. (auth)

16253 RETENTION OF ^{137}Cs AND ^{90}Sr ADMINISTERED IN LETHAL DOSES TO RATS. Thomas, R. G.; Thomas, Randi L.; Wright, S. R. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Contract AT(29-2)-1013. Amer. Ind. Hyg. Ass. J., 29: 593-600(Nov.-Dec. 1968).

Large doses of ^{90}Sr and ^{137}Cs, singly and in combination, were injected intraperitoneally into rats. Altered whole-body retention patterns were observed with high levels of both radionuclides; the rate of ^{90}Sr excretion decreased, while that of ^{137}Cs increased. Urine-to-feces ratios remained constant with time and were similar to those observed after administration of tracer quantities of either radionuclide. A long-term component of ^{137}Cs retention resulted from a small fraction residing in the skeleton. Kinetics of retention of the mixtures were predictable from the behavior of the individual radionuclides. (auth)

16254 ABSORPTION OF ^{35}S-GSH AND ITS INCORPORATION INTO PROTEIN IN RATS. Kubo, Yasuhiko (Kurume Univ., Japan). Kurume Med. J., 15: 113-25(Sept. 1968).

Intestinal absorption of ^{35}S-GSH in rats was studied in vivo and in vitro, as well as the incorporation of GSH into serum proteins. A significant amount of GSH which had been injected into the jejunum was absorbed and detected in portal plasma, particularly after cycloheximide treatment. Using the everted sac method, it was demonstrated that a small amount of GSH crossed the intestinal wall. Sulfur-35 of GSH was rapidly incorporated into serum proteins in vivo, and cycloheximide markedly inhibited this reaction. (NSA of Japan)

16255 ALBUMIN MACROAGGREGATES LABELLED WITH ^{113m}In FOR LUNG SCINTISCANNING. Ciscato, V. A. (Univ. of Buenos Aires); Nicolini, J. O.; Palcos, M. C. Int. J. Appl. Radiat. Isotop., 20: 115-19(Feb. 1969).

A technique is described for the preparation of human serum albumin macroaggregates, which can be supplied by the CNEA and labelled with ^{113m}In by the users, to be applied in lung scintiscanning. Particle sizes range from 10 to 150 μ. The labeling technique is simple and takes 10 min. The final preparation is sterilized by autoclaving. Distribution studies in experimental animals were made and showed a radioactivity retention in the lungs over 95%, 30 min after intravenous injection. (auth)(UK)

Ecology

Refer also to abstracts 16236, 16282, 16291, and 16390.

16256 (NIRS-7, pp 83-97) ENVIRONMENTAL STUDIES. (National Inst. of Radiological Sciences, Chiba (Japan)).

Studies were conducted on whole-body retention of ^{137}Cs in young mice. Biliary excretion of plutonium following intratracheal administration or inhalation in rats was studied. Uptake of ^{85}Sr and ^{45}Ca by rats from brown seaweeds was determined. Comparative studies were made on retention and distribution of ^{137}Cs and ^{86}Rb in rats. Accumulation and excretion of ^{106}Ru ingested by fish (Acanthogobius flavimanus) were determined. Studies on radioactive contamination of fruit trees by fission products included mobility of radioactive fallout ^{137}Cs in orchard soils and concentrations of ^{137}Cs and ^{90}Sr in Satsuma orange fruit. Studies were conducted on secretion rate of dietary iodine into human milk. Lead-210 content in foodstuffs and its dietary intake in Japan were examined. Studies were made on the content of ^{90}Sr and ^{137}Cs in soybeans and their products. Concentration of ^{85}Sr and ^{106}Ru from sea water by clams was investigated. Atomic absorption spectrophotometry was used for barium determinations. Studies were made on the relationship between body burden and daily urinary excretion of ^{137}Cs. (H.L.W.)

Genetics and Cytogenetics

Refer also to abstracts 16251, 16376, 16432, 16436, 16442, and 16444.

16257 (NIRS-7, pp 55-65) GENETICS. (National Inst. of Radiological Sciences, Chiba (Japan)).

Effects of acute x-irradiation on sex-linked lethal mutation frequency in Drosophila melanogaster were investigated. Studies on the relative biological effectiveness of mutagenic effects induced by neutrons and x rays on Drosophila were conducted. Repair of uv-induced back mutations in yeast were studied. Changes in mutational response by storage of silkworm sperm treated with alkylating agents were determined. Respiration-deficient mutations were induced in yeast by uv light. Patterns of complete and mosaic mutations induced by triethylene melamine in Drosophila were compared. The probability of fixation of mutant genes with discrete generations was studied. A study was made on the frequency distribution of lethal chromosomes in finite populations. Studies were made on the population dynamics of deleterious inversion chromosomes and frequency distribution of lethal chromosomes in small populations of Drosophila. (H.L.W.)

16258 (ORNL-tr-1928) CHROMOSOMES AND RADIATIONS: STUDY OF 12 OCCUPATIONALLY EXPOSED SUBJECTS AFFECTED BY RADIODERMITITIS. Mouriquand, C.; Patet, J.; Darnault, J.; Gilly, C.; Jalbert, P.; Wolff, Ch. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Bull. Inform. Sci. Tech. (Paris), No. 94, 3-24(June 1965). 26p. Dep. CFSTI.

The chromosomes of twelve subjects occupationally exposed to x ray and affected with radiodermatitis of the hands here compared with the chromosomes of normal subjects. The frequency of structural aberrations was much higher with the exposed subjects and they persisted for a long time after irradiation has been stopped. The relation of the aberrations to irradiation is discussed as well as the signification of chromatid aberrations, and the probability of definitive cytogenetic alterations in some lymphoid areas. (auth)(C.O.)

16259 THE EFFECT OF GAMMA-RAYS ON HUMAN CHROMOSOMES. II. A STATISTICAL ANALYSIS OF DISTRIBUTION OF ABERRATIONS AMONG THE CELLS. Luchnik, N. V.; Bochkov, N. P.; Sevan'kaev, A. V. (Inst. of Medical Radiology, Obninsk, USSR). Genetika, 5: 129-35(Jan. 1969). (In Russian).

The distribution of chromosome aberrations among human lymphocytes irradiated in vitro by gamma-rays at doses within the range of 25 to 400 R was studied. The following facts were revealed by the statistical analysis of the data obtained. All the types of aberrations investigated (i.e., acentric fragments, dicentrics, centric rings and minutes) occur in the cells independently from one another. The theoretical distribution of each aberration type among the cells follows the Poisson series. At least 98% of asymmetrical exchanges are complete, i.e., each dicentric is accompanied, as a rule, by only one pair of fragments. The total number of breaks per cell (assuming, that the exchange is the result of two breaks) shows a very irregular distribution. The number of aberrations per cell is, on the contrary, in a very good agreement with the Poisson distribution. (auth)

16260 THE EFFECT OF HEAT TREATMENT AND GAMMA-IRRADIATION OF THE SEEDS OF ARABIDOPSIS THALIANA(L.) HEYNH. ON THE MUTATION RATE IN M_2. Nikolov, Ch. V.; Ivanov, V. I. (Moscow Univ. Inst. of Medical Radiology, Obninsk, USSR). Genetika, 5: 168-70(Jan. 1969). (In Russian).

Air-dried dormant seeds of Arabidopsis thaliana (6 to 7 per cent water content) were subjected to γ-irradiation (40 kr) accompanied by pre-, post-, or both pre- and post-irradiation heat treatment (30 min. at 100°C). The frequency of the cotyledon and the later chlorophyll and morphological mutations was determined in M_2 and verified in M_3. The nature of the cotyledon mutations as yet remains obscure. The frequency of radiation induced mutations affecting later developmental stages was increased by the action of post-irradiation heat treatment, somewhat decreased by the heat pretreatment, and remained unchanged in the case of pre- and post-irradiation heat treatment. (auth)

16261 STUDIES ON VARIETAL DIFFERENCES IN RADIOSENSITIVITY IN RICE. III. RADIOSENSITIVITIES WITH RESPECT TO THE REDUCTION IN THE NUMBER OF DIVIDING CELLS AND THE OCCURRENCE OF CHROMOSOME BRIDGES. Ukai, Yasuo (Tokyo Univ.). Ikushugaku Zasshi, 18: 221-8(1968). (In Japanese).

Marked varietal differences in the radiosensitivity were observed in the dose-response curves for the number of anaphase in the first mitosis of the root tip meristem when dry seeds of rice varieties were exposed to γ rays. The sensitivity with respect to the reduction in the number of anaphase was closely correlated to the sensitivity in root length. No clear differences were exhibited in the frequency of the cells with chromosome bridges. (auth)

16262 CYTOGENETIC SEQUELAE IN THE BONE MARROW CELLS OF MICE FOLLOWING A WHOLE-BODY AND LOCAL

IRRADIATION. Bikkulov, R. I.; Grechishkin, S. V. (Leningrad Scientific-Research Inst. of Radiation Protection). Vestn. Akad. Med. Nauk SSSR, No. 12, 80-3(1968). (In Russian).

Data on changes in the frequency of chromosomal readjustments in the bone marrow cells of mice exposed to various doses of a preliminary whole-body irradiation of the abdominal region is presented. With a two-fold whole-body irradiation, the bone marrow cells of mice demonstrate a smaller number of cells with chromosomal disturbances, compared to animals subjected to one-time irradiation. Secondary to two-fold and single local irradiation the number of cells presenting chromosomal disturbances increases practically to the same extent. (auth)

16263 SECTORIAL MANIFESTATION OF INDUCED MUTATIONS IN THE PLANT OF VICIA SATIVA L. Zannone, L. (Istituto Nazionale di Genetica per la Cerealicoltura, Rome). Genet. Agr., 22: 52-61(Feb. 15, 1968). (In Italian).

The genetic effects of chemical (ethyl methane sulphonate = EMS, ethylene immine = EI) and physical (x rays, γ rays and fast neutrons = R) mutagens in Vicia sativa L. were analyzed and the chimaeric localization of induced mutations was considered. Treatments were applied to dormant seeds, at doses corresponding to D 50 (doses which reduce by fifty per cent the M_1 seedling height at the stage of third leaf open). Genetic effects were evaluated, both the chlorophyll and for morphological mutations, on the basis of the percentage of M_1 segregating plants, mutations per M_1 plant-progeny, M_1 segregating branches, mutations per M_1 branch-progeny, M_1 mutants. The EMS effects are always greater than those of EI and R. Differences between EI and R are insignificant for the chlorophyll mutations and more notable for the morphological ones. Induced mutations are chimaeric, but there is no preferential localization in one special branch of the plant. (auth)

16264 ALLELIC MUTATIONS OF ARABIDOPSIS THALIANA INDUCED BY ^{60}Co γ RAYS. Kas'yanenko, A. G.; Usmanov, P. D. (Inst. of Physiology and Biophysics of Plants, Dushanbe, USSR). Dokl. Akad. Nauk Tadzh. SSR, 11: No. 5, 69-73(1968). (In Russian).

Phenotypic studies were made of allelic mutations in Arabidopsis thaliana induced by 80 kr γ radiation of air-dried seeds. Most of the allelic mutations producing zygotes containing the dominant gene CH_1/CH_2 were nonviable or lethal. It was concluded that mutations induced by γ radiation were truly factorial mutations. The mutation chlorine 80/2 could be used for induced factorial mutations in order to study intragenic recombination. (R.V.J.)

16265 DOSAGE AT THE SCUTE LOCUS, AND CANALISATION OF ANTERIOR AND POSTERIOR SCUTELLAR BRISTLES IN DROSOPHILA MELANOGASTER. Scowcroft, W. R. (Commonwealth Scientific and Industrial Research Organization, Canberra); Green, M. M.; Latter, B. D. H. Genetics, 60: 373-88 (Oct. 1968).

The effects on scutellar bristle number in Drosophila melanogaster of one, two and three doses of the scute locus in males, and two, three and four doses in females have been determined for three different alleles. It has been clearly demonstrated that the posterior scutellar bristles are more strongly canalised than the anterior scutellars and that they respond differently to increasing dosage of the scute locus. Further, the bristle thresholds responsible for canalisation at four scutellar bristles are quite differently determined. The specification of the $^3/_4$ bristle threshold on the underlying scale for scutellars is primarily a function of the $^1/_2$ threshold for posterior bristles, while the $^4/_5$ threshold depends almost exclusively on the relative position of the $^2/_3$ threshold for anterior bristles. These findings indicate that a single developmental scale does not adequately describe the phenomenon of canalisation of scutellar bristles. (auth)

16266 PHENOL OXIDASES AND MORPHOGENESIS IN PODOSPORA ANSERINA. Esser, Karl (Ruhr-Univ., Bochum, Ger.). Genetics, 60: 281-8(Oct. 1968).

In the Ascomycete Podospora anserina the two allelic genes m-1 and m-2, located in linkage group IV, have pleiotropic effects. They cause a drastic reduction in perithecial size and a reduction in the formation of melanin pigments of the mycelia. The expression of the mutant phenotype is abolished by the action of a suppressor gene (su-m) which could be localized by tetrad analysis in linkage group III. Appropriate enzyme analyses have revealed that the alteration in pigmentation of the mutants depends on the formation of a qualitatively altered laccase (polyphenol oxidase). Since the action of the suppressor gene not only repairs the morphogenetic defect but also restores this enzyme alteration to the wild-type level, it may be concluded that formation of laccase and morphogenesis of perithecia are correlated. These findings may be used as a basis for further studies of the genetical and biochemical control of morphogenesis. (auth)

16267 GENETIC PROPERTIES OF DNA TRANSFERRED FROM ULTRAVIOLET-IRRADIATED Hfr CELLS OF ESCHERICHIA COLI K-12 DURING MATING. Wilkins, Brian M.; Howard-Flanders, Paul (Yale Univ., New Haven). Genetics, 60: 243-55 (Oct. 1968).

The genetic properties of DNA transferred during mating from Escherichia coli K-12 Hfr cells which contain unexcised pyrimidine dimers have been investigated. Mutants which carry a uvr mutation are defective in the ability to excise ultraviolet-induced pyrimidine dimers from DNA. Genetic transfer during mating is slightly retarded by UV irradiation of Hfr uvr B5 cells with 200 ergs/mm^2. Although exposure of uvr B5 donor cells to low UV doses (25 ergs/mm^2) reduces the number of recombinants to 35% of the control value, the yields are not further affected by increasing doses up to 250 ergs/mm^2. In contrast, the colony-forming ability of the irradiated cells decreases exponentially. The percentage of recombinants carrying female markers at closely linked, unselected, proximal loci increases when Hfr cells contain unexcised dimers at the time of mating. This increase is independent of the ability of the F^- cells to excise dimers and is not further affected if merozygotes derived from uvr^+ recipients are irradiated immediately after mating. These results suggest that dimers can be transferred in the Hfr chromosome during mating. The transferred DNA, presumably replicated during transfer, contains defects which are not repaired by the excision process in the recipient before recombination. It is postulated that these defects consist of discontinuities, or gaps, which are in the newly synthesized strand opposite the dimers in the parental strand. The altered recombination frequencies may reflect the initiation of genetic exchanges by either the free ends adjacent to the gaps, or the single-stranded regions in the opposite strand, and the subsequent integration of short fragments of the exogenote into the female chromosome. Recombination may tend to occur following the replication of DNA containing UV-damaged bases because the stabilized gaps formed in the replicated structure may permit pairing and the initiation of genetic exchanges. (auth)

16268 RADIOSENSITIVITY OF CONIDIOSPORES TO THERMAL NEUTRONS AND ISOLATION OF MUTANTS OF TRICHODERMA GLAUCUM ABBOTT. Dnyansagar, V. R.; Khatri, A. A. (Inst. of Science, Bombay). Indian J. Exp. Biol., 7: 31-3(Jan. 1969).

The spore suspensions of T. glaucum were irradiated outside the core of the reactor as well as in thermal cavity with the neutron flux varying from 10^{12} to 30×10^{12} n/cm^2/sec in the core area and from 10^7 to 10^8 n/cm^2/sec in thermal cavity. The spores were killed exponentially with increasing dosages. Thermal neutrons induced morphological nutritional mutants. The morphological mutants exhibited wide range of characters and synthesized lesser quantity of gliotoxin as compared to the wild strain. (auth)

16269 MUTANTS OF ESCHERICHIA COLI UNABLE TO BE LYSOGENIZED BY THE TEMPERATE BACTERIOPHAGE P2. Sironi, G. (Karolinska Institutet, Stockholm. Univ., Milan). Virology, 37: 163-76(Feb. 1969).

From Escherichia coli C lysogenization defective (lyd) mutants have been isolated. They are unable to become lysogenic for phage P2, although able to be lysogenized by other temperate phages. The lyd mutants show several new properties, as compared to the original strain: (1) higher sensitivity to x rays or uv light (but they reactivate normally uv-irradiated T1); (2) lower recombination frequencies in bacterial crosses; (3) lower transduction frequencies in P1-mediated transduction. The lyd mutation maps in proximity of the xan marker on the E. coli C chromosome. Crosses between P2-lysogenic donors and lyd recipients have shown that the lyd mutation is not a deletion of a prophage attachment site. No lyd (P2) recombinants could be recovered from such crosses. Spontaneous mutants overcoming lysogenization defectiveness (old) have been isolated from P2. They are able to lysogenize lyd cells. These mutants are homoimmune with P2. In mixed infection experiments with P2 and P2 old, P2 old does not help P2 in lysogenizing lyd mutants. The data suggest that the old^+ gene of P2 inhibits lysogenization of lyd cells by making all infected lyd cells inviable and that the phenomenon does not depend on an abnormal immunity or on a failure in the process of attachment of the phage to the host chromosome. (auth)

16270 CORRELATION OF SEEDLING HEIGHT AND CHROMOSOMAL DAMAGE IN IRRADIATED BARLEY SEEDS. Conger, Alan D.; Stevenson, Harlan Q. (Temple Univ., Philadelphia). Radiat. Bot., 9: 1-14(Feb. 1969).

The most commonly used measurement of radiation damage to

seeds is seedling height, the mean height a lot of seeds attains at some time during exponential growth. If planted immediately post-irradiation, seeds of a given dose lot give a normal height distribution, but if stored before planting give very abnormal and even bimodal height distributions. By within-seed comparisons of chromosome abnormality (from roots excised at 24 to 36 hr) with height (attained by 7 to 9 days) in irradiated barley seeds, it is shown that damage to height and to chromosomes are closely correlated, even within a treatment in which great heterogeneity occurs. The two effects have equal radiosensitivity, but different shoulders to their dose curves. Seedling height is not depressed until 25 to 30% of the cells bear chromosomal abnormalities. The heterogeneity observed is not due to a between-seed heterogeneity in dose or in oxygen content, and probably not in moisture. The experiments described showed that the heterogeneity arises from factors that operate on post-irradiation (indirect) storage damage, but are without effect on during-irradiation damage (direct). (auth) (UK)

16271 A DEVELOPMENTAL STUDY OF INDUCED SOMATIC MUTATIONS IN GLADIOLUS. Buiatti, M.; Tesi, R.; Molino, M. (Univ. of Pisa). Radiat. Bot., 9: 39-48(Feb. 1969).

The fate of somatic mutations induced by γ-rays in Gladiolus var. Oscar was followed through the life of the plant. Dormant corms were treated with 4000 and 6000 R and mutation frequencies per plant and per flower order, as well as sector area distribution, were calculated. Mutated cell lineages could be traced through whole plants and diagrams were drawn. Data on mutated sector sizes suggested that a petal could derive from either 1, 2 or possibly more initial cells. Mutations were found to cover more than one flower and to be induced before flower differentiation in the spike primordium of the dormant corms. Sector areas were greater and mutation frequencies lower in top flowers than in bottom flowers. The implications of these results in relation to Gaul's theory of diplontic selection are discussed. (auth) (UK)

16272 THEORETICAL STUDIES ON THE METHODOLOGICAL PROCEDURES OF RADIATION BREEDING. VII. ADEQUATE GENERATION AND METHOD FOR SELECTION IN AUTOGAMOUS PLANTS FOLLOWING SEED IRRADIATION. Yoshida, Y.; Tsuru, M.; Kitahara, S. (Kyushu Agricultural Experiment Station, Japan). Radiat. Bot., 9: 15-20(Feb. 1969).

The following conclusions were reached after considering the population sizes and field areas for detecting one or more desirable mutants in X_2, X_3 or X_4. (1) The relative efficiency of the "one-plant-one-grain method" increases with increase of generations when the first selection is performed in X_2, X_3 or X_4. (2) No single generation will give all the advantages when X_2, X_3 or X_4 is the first selective generation. Although the breeder may choose the most suitable generation for his own requirements, X_4 or X_3 would be superior to X_2 for the initial selection. (3) It is not advantageous to select for desirable mutants again in X_3 after the first selection in X_2 nor in X_4 after the first and second selections in X_2 and X_3 respectively. These findings were evaluated mainly by reference to the probabilities that one or more plants with the desirable mutant allele in homozygous recessive form will appear out of X_2- X_3- or X_4-populations. (auth) (UK)

16273 GENETIC CONTROL OF RECOMBINATION IN DROSOPHILA. Lindsley, D. L. (Oak Ridge National Lab., Tenn); Sandler, L.; Nicoletti, B.; Trippa, G. pp 253-69 of Replication and Recombination of Genetic Material. Peacock, W. J. (ed.). Canberra, Australia, Australian Academy of Science, 1968.

From International Conference on Replication and Recombination of Genetic Material, Canberra, Australia. See CONF-670822.

The phenomena of pairing, exchange, and separation of homologous chromosomes are discussed in relation to the genetic control of recombination. The various steps in recombination that are affected by transcriptional events in the genome were studied. Mutations induced by radiations and chemical mutagens that were used to determine transcription of the genome are discussed and a systematic search for mutants of genes that controlled meiotic and mitotic processes, including recombination, was carried out. It was found that mitotic and meiotic recombinations were similar in the physical process itself, in the gene order of the maps generated, and in response to sequential heterozygosity for other chromosomes (the interchromosomal effect). They differed in the relative distances in the maps produced, in response to sex differences, the effects of Minutes, and the meiotic mutant, c(3)G. Both systems were labile to a great variety of environmental agents such as x radiation, age, and temperature. (C.O.)

16274 REPLICATION AND RECOMBINATION OF GENETIC MATERIAL. International Conference held at Canberra, Australia, August 28–Sept 1, 1967. Peacock, W. J.; Brock, R. D. (eds.). Canberra, Australia, Australian Academy of Science, 1968. 283p. (CONF-670822).

Of the 24 papers presented at the conference, nine were within the scope of NSA; a separate abstract for each of the nine papers was prepared. (C.O.)

For abstracts of individual papers see: 16249–16251, 16273, 16275–16278, and 16444.

16275 CAFFEINE-DEATH AND A THEORY OF CHROMOSOME BREAKAGE: AN EXCISION-REPAIR SUICIDE MODEL. Grigg, G. W. (Commonwealth Scientific and Industrial Research Organization, Sydney). pp 120-33 of Replication and Recombination of Genetic Material. Peacock, W. J. (ed.). Canberra, Australia, Australian Academy of Science, 1968.

From International Conference on Replication and Recombination of Genetic Material, Canberra, Australia. See CONF-670822.

A theory of chromosome breakage that was evolved from study of the mechanism of caffeine death in Escherichia coli is presented. Caffeine death is described and partial inhibition of the excision-repair process, e.g., dark repair of uv- and x ray-induced genetic lesions, by caffeine is proposed as the cause of death. The model is extended to account for the induction of lethal events in E. coli by pyrophosphate and 5-bromouracil. Finally, the model is generalized as a theory of chromosome breakage in higher organisms. (C.O.)

16276 THE REPLICATION OF DNA CONTAINING PHOTOPRODUCTS AND UV-INDUCED GENETIC RECOMBINATION. Howard-Flanders, Paul; Rupp, W. Dean; Wilkins, Brian M. (Yale Univ., New Haven). pp 142-51 of Replication and Recombination of Genetic Material. Peacock, W. J. (ed.). Canberra, Australia, Australian Academy of Science, 1968.

From International Conference on Replication and Recombination of Genetic Material, Canberra, Australia. See CONF-670822.

The question of what happens in uv-irradiated Escherichia coli when DNA containing damaged bases is replicated was investigated. In excision-defective bacteria exposed to 30 to 90 ergs/mm^2 of uv light, the gaps in newly synthesized daughter strands were identified. Spacing between such gaps was about equal to the spacing between pyrimidine dimers. Reasons were given for thinking that such gaps may also be formed when DNA containing uv-photoproducts is replicated during transmission between conjugating cells and that the gaps may be opposite the pyrimidine dimers. The structure so formed did not appear to be subject to repair by excision and the internal ends at these gaps were considered as tending to promote genetic exchanges. (C.O.)

16277 GENETIC RECOMBINATION IN FUNGI. Holliday, Robin (National Inst. for Medical Research, London). pp 157-74 of Replication and Recombination of Genetic Material. Peacock, W. J. (ed.). Canberra, Australia, Australian Academy of Science, 1968.

From International Conference on Replication and Recombination of Genetic Material, Canberra, Australia. See CONF-670822.

Genetic recombination in fungi is reviewed and a model for this phenomenon is presented. Consideration was given to the involvement of DNA synthesis, the chromosome breaking process, gene conversion by repair, fine structure maps, negative interference, pairing problems, recombination of polyneme chromosomes, mitotic recombination in diploid species, and uv-radiosensitivity of mutants of the smut fungus (Ustilago maydis) and their effect on recombination, i.e., the possible role of repair processes in recombination. It was concluded that no mechanism for how recombination occurs could be stated with certainty. (C.O.)

16278 LYSOGENY AND BACTERIAL RECOMBINATION. Holloway, B. W.; Van De Putte, P. (Univ. of Melbourne). pp 175-83 of Replication and Recombination of Genetic Material. Peacock, W. J. (ed.). Canberra, Australia, Australian Academy of Science, 1968.

From International Conference on Replication and Recombination of Genetic Material, Canberra, Australia. See CONF-670822.

A new class of recombination deficient mutants was isolated in Pseudomonas aeruginosa. They showed a reduced ability to be lysogenized by temperate phages, a reduced formation of recombinants in transduction and conjugation, and a partial increase in radiosensitivity. When lysogenized by inducible phages they showed a marked decrease in inducibility following uv irradiation. The recombination deficiency was not due to the breakdown of DNA when it had entered the bacteria as shown by high plating efficiency of a range of bacteriophages. One rec$^-$ mutant became partially rec$^+$ when grown at 30°. This same mutant failed to grow at 42°

and showed a decreased genetic synthesis of DNA at this temperature. Preliminary evidence indicated a possible relationship between the altered capacity for DNA synthesis at 42° and the lesion responsible for the rec⁻ phenotype at 37°. (C.O.)

16279 INDUCTION OF ANEUPLOIDS IN HEXAPLOID OATS, AVENA SATIVA L., THROUGH X-IRRADIATION. Maneephong, C.; Sadanaga, K. (Iowa Agricultural and Home Economics Experiment Station, Ames. Dept. of Agriculture, Ames, Iowa). Contract AT(11-1)-1276. Crop Sci., 7: 522-3(Sept.-Oct. 1967). (COO-1276-4).

Aneuploids were induced in the hexaploid oat variety Cherokee through x radiation (300 R, 500 R, 700 R) of panicles in the preanthesis stage. The X_1 and control plants were examined for abnormal tetrads (micronuclei in tetrads), and plants with more than 15% abnormal tetrads were classified abnormal and saved as potential sources of aneuploids and translocations. The percentage of abnormal plants was related to the x ray treatments. Although the percentage (6.4) of monosomics was highest in the 700 R treatment, it was concluded that the 300 R treatment (4.9%) was most efficient in producing monosomics since it was associated with the lowest percentage of translocations. (auth)

Health Physics and Safety

Refer also to abstracts 15782, 15832, 15996, 16081, 16092, 16180, 16363, 16375, 16419, 16431, 16852, and 17026.

16280 (BNL-13157) DOSIMETRY OF ^{252}Cf. Fairchild, R. G. (Brookhaven National Lab., Upton, N. Y.). [1968]. 10p. (CONF-681032-3). Dep. CFSTI.

From Symposium on Californium-252, American Nuclear Society, New York.

Radiation dose measurements of californium-252, which delivers a mixed radiation field composed of ~37% gamma rays and of 63% fast neutrons, are described. The measurements consisted of absorbed dose, oxygen enhancement ratio (ratio of doses that give the same biological effect in the absence and presence of oxygen), and RBE. (B.G.D.)

16281 (BNWL-966) RADIATION PROTECTION ASPECTS OF THE MOVEMENT OF RADIOACTIVE LIQUID WASTE IN RAILROAD TANK CARS. King, G. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 1969. Contract AT(45-1)-1830. 10p. Dep. CFSTI.

Liquid radioactive waste generated in Battelle-Northwest 300 Area operations is collected in storage tanks and subsequently transported to Atlantic Richfield Hanford Company facilities in the 200 Areas, about 30 miles away, for disposal. Prior to 1968, this waste was hauled in tank trucks with a capacity of 5,000 gallons each. Beginning in January 1968, railroad tank cars with a capacity of 20,000 gallons each were used for transporting the waste. As experience was gained with the railroad tank cars, some radiological control problems arose. Control of contamination on the rail cars and in the loading area became difficult and was complicated by significant dose rates from the cars. These problems and methods devised to cope with them are discussed. (auth)

16282 (COO-1333-1) INVESTIGATIONS INTO THE CYCLING AND RECYCLING OF CERTAIN RADIONUCLIDES THROUGH THE MILK FOOD CHAIN. Final Report, December 15, 1963-December 14, 1966. Pelletier, Charles A.; Whipple, G. Hoyt (Michigan Univ., Ann Arbor. School of Public Health). Dec. 1968. Contract AT(11-1)-133. 145p. Dep. CFSTI.

This study of radionuclide behavior in the milk-food chain was conducted at a commercial dairy farm near Tecumseh, Michigan, during 1964 and 1965. The main purpose of the study was to develop mathematical models to describe the movement of radionuclides from air to milk. Three models are presented: the first predicts total deposition on the ground from air concentration and rainfall rate; the second predicts concentration in forage from air concentration, rainfall rate, and the rates at which the forage grows and is consumed by the dairy herd; the third predicts the concentration of cesium-137 in milk from the concentration of cesium-137 in each type of feed and the rate at which each type of feed is consumed by the dairy herd. The models predict a single week's deposition to within a factor of 3, a single week's forage concentration to within a factor of 2.2, and a single week's cesium-137 concentration in milk to within a factor of 1.7. The error associated with each model becomes smaller as one increases the number of weeks over which the prediction is averaged. (auth)

16283 (EGG-1183-2165(Rev.)) NUCLEAR ACCIDENT DOSIMETRY: DEPTH-DOSE CONSIDERATIONS. Technical Number S-394-R. Humpherys, K. C.; Sayeg, J. A. (EG and G, Inc., Santa Barbara, Calif.). Oct. 1968. 46p. Dep. CFSTI.

Experimental and theoretical determinations of depth-dose patterns in tissue-equivalent phantoms are examined and the results are compared to determinations of kerma or free-in-air dose based on a single interaction. The generally good agreement between theoretical and experimental results indicates that calculational techniques may be used to determine depth dose from nuclear-accident-dosimetry fluence measurements made with threshold foils and gamma-ray dosimeters positioned in free air. A technique is also described for measuring depth dose with threshold foils in small volumes by elimination of the ^{239}Pu foil and ^{10}B shield. (auth)

16284 (EGG-1183-2185) TISSUE DOSE SPECTRA FOR HENRE ACCELERATOR. Number S-428-R. Lucas, A. C. (EG and G, Inc., Santa Barbara, Calif.). June 1968. Contract AT(29-1)-1183. 23p. Dep. CFSTI.

Dose and LET spectra have been measured at various distances from the HENRE source. The spectrum was found to be considerably degraded for the distances involved (greater than 87 feet). A quality factor of 8 ± 1 was found to apply for radiation protection purposes at the distances considered. (auth)

16285 (LA-4074) HEALTH PHYSICS AT THE LOS ALAMOS "WING 9" HOT-CELL FACILITY. Valentine, Allen; Fitzgibbon, Francis; Martinez, Leopoldo (Los Alamos Scientific Lab., N. Mex.). Dec. 1968. Contract W-7405-eng-36. 13p. Dep. CFSTI.

Health physics programs at the Los Alamos Wing 9 hot cell facility are described. The 16-cell facility is used primarily for testing and examination of irradiated reactor fuel, but it is also the main LASL facility for materials irradiation, large source handling, and other miscellaneous hot-cell work. Eight cells are equipped with sealed alpha containment boxes for safe handling of plutonium enriched fuels. Control systems and operating practices that affect health physics at the facility are discussed as well as health physics programs such as area monitoring, personnel dosimetry, air monitoring, surface monitoring, and monitoring instrumentation. (auth)

16286 (LA-4076) AIR MONITORING AND ITS EVOLUTION AT THE LASL PLUTONIUM FACILITY. Valentine, Allen M.; Meyer, Dean D.; Romero, William F. (Los Alamos Scientific Lab., N. Mex.). Jan. 1969. Contract W-7405-eng-36. 11p. Dep. CFSTI.

A program to monitor airborne contamination in the working environment of a plutonium facility is discussed. Only those aspects most closely associated with operational monitoring are included and, as a result, several side topics in the realm of air monitoring are not mentioned. Techniques, equipment, records, and philosophy are discussed, in addition to air concentration trends, equipment evolution, cost, manpower requirements, and inherent shortcomings. For the present air monitoring program, 351 samples are collected daily on HV-70 filters at fixed locations in work areas and counted in automatic alpha counting systems. Counting results are interpreted in terms of air concentrations and recorded for evaluation by the health physics and operating staff. Also, 21 commercial continuous air monitoring devices are located throughout the work areas. (auth)

16287 (MIT-952-5(Pt.2)) RADIUM AND MESOTHORIUM POISONING AND DOSIMETRY AND INSTRUMENTATION TECHNIQUES IN APPLIED RADIOACTIVITY. Annual Progress Report, Part II. Evans, Robley D.; Kolenkow, Robert J. (Massachusetts Inst. of Tech., Cambridge. Dept. of Physics). May 1968. Contract AT(30-1)-952. 38p. Dep. CFSTI.

Separate abstracts were prepared for each of the sections presented. (B.G.D.)

For abstracts of individual sections see: 16222, 16288, and 16289.

16288 (MIT-952-5(Pt.2), pp S.24-35) DOSIMETRY. (Massachusetts Inst. of Tech., Cambridge. Dept. of Physics).

The theoretical and experimental aspects associated with a new method for measuring the range-energy relation for alpha particles in water using thick-source alpha spectroscopy and silicon surface-barrier detectors are discussed. Preliminary data are also presented. (B.G.D.)

16289 (MIT-952-5(Pt.2), pp S.36-8) URANIUM MINE DOSIMETRY AND RADIATION CONTROL. (Massachusetts Inst. of Tech., Cambridge. Dept. of Physics).

Build-up and decay curves of alpha activity from 3-min-old air and equilibrium air on filters are presented. (B.G.D.)

16290 (MORP-68-14) RADIATION SAFETY RECOMMENDATIONS FOR X-RAY DIFFRACTION AND SPECTROGRAPHIC EQUIPMENT. Moore, Thomas M.; McDonald, Donald J. (National Center for Radiological Health, Rockville, Md.). Oct. 1968. 17p.

Radiation protection recommendations for x-ray diffraction and spectrographic equipment are presented including guidelines for administrative responsibilities, operating procedures, personnel monitoring, area monitoring, and safety engineering. They are directed to operators, administrators, governmental health agencies, and manufacturers. (auth)

16291 (ORNL-TM-2343) PRELIMINARY ESTIMATION OF EROSION AND RADIOCESIUM REDISTRIBUTION IN A FESCUE MEADOW. Dahlman, Roger C.; Auerbach, S. I. (Oak Ridge National Lab., Tenn.). Nov. 1968. Contract W-7405-eng-26. 24p. Dep. CFSTI.

The potential radioactivity redistribution was evaluated for observed and hypothetical conditions of precipitation prior to application of a fallout simulant to fescue vegetation. Estimates from this analysis were compared with those of the radionuclide movement experiment from Area 0807 and also compared with predictions of erosion using the Wischmeier and Smith soil-loss equation. Based on observed erosion loss as a function of different precipitation events, approximately 0.06% of the ^{137}Cs contaminant will move from each contaminated area annually, and the input to the natural drainage system will be less than 2 mCi from 4-100 m^2 plots. This estimate is one-fortieth of other independent predictions and measurements because the dense fescue vegetation and sod of the simulant-plots greatly reduce erosion and mineral element loss in runoff. (auth)

16292 (RD/B/N-1274) DOSE ARISING FROM INHALATION OF NOBLE GASES. Whitton, J. T. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Dec. 1968. 15p. Dep. CFSTI.

Dose distributions in a person exposed to a cloud of noble gas are affected by the presence of the gas in the blood stream after inhalation. The diffusion and solubility coefficients of various noble gases in the body were estimated from the biological literature and used to calculate the gonad dose from inhalation of ^{85}Kr. It is shown that this is only 1% of that from the gammas and bremsstrahlung from external irradiation which in turn is only 1% of the skin dose. Simple considerations show that no seriously larger corrections are needed for the other radioactive noble gases. (auth)

16293 (TID-24967) RADIOLOGICAL EMERGENCY PROCEDURES FOR THE NON-SPECIALIST. (Atomic Energy Commission, Washington, D. C.). Jan. 1969. 39p. GPO $0.50.

A handbook on radiological emergency procedures for the non-specialist who may find himself at the scene of an accident involving radioactive materials is presented. The handbook covers familiar and unfamiliar hazards, brief introduction to nuclear radiation, conventional and nuclear weapons, emergency methods, sequence of emergency procedures, and suggestions for instructors. (B.G.D.)

16294 URANIUM MINE-SAFETY CONTROVERSY. Nucl. News, 12: No. 2, 24-6(Feb. 1969).

The development of health and safety standards to protect uranium miners from the carcinogenic agent, radon and its decay daughters, is described. The Federal Radiation Council has recommended a current maximum exposure limit of 6 Working Level Month (WLM) in any consecutive 3 months, and 12 WLM per year, and that the industry should strive to improve mining conditions and monitoring practices so that, by 1971, the limit can be set at 4 WLM per year. (L.C.L.)

16295 RADIOACTIVE CONTAMINATION OF FRUIT TREES BY FISSION PRODUCTS. 1. DISTRIBUTION OF FALL-OUT ^{137}Cs IN THE ORCHARD (IN 1965). Shiraishi, Yoshiyuki; Okabayashi, Hiroyuki (National Inst. of Radiological Sciences, Chiba, Japan). Soil Sci. Plant Nutr. (Tokyo), 38: 333-8(Sept. 1967). (In Japanese).

The ^{137}Cs concentration at various soil depths was investigated in 1965 in the (tangerine) orchard volcanic-ash soil, Kanagawa Prefecture. The ^{137}Cs concentrations per unit volume in the orchard soil were of an exponential nature at a depth of 0 to 30 cm. Particular mobility factors existed in the clear tilled, the dry-leaf scattered and the grass grounds, and the trodden (orchard) path. Furthermore, in the orchard grounds there was a single mobility factor, while there were two different mobility factors in the path. By means of the mobility factor, studies were made on the mobility-factor values for general soils, the ^{137}Cs concentrations near the ground surface, the total cumulative amounts, the concentration distribution at depths, and so on. (NSA of Japan)

16296 DECONTAMINATION OF RADIOACTIVELY CONTAMINATED EQUIPMENT. Raviv, Szmuel. British Patent 1,142,776. Feb. 12, 1969. Filed Sept. 18, 1967.

A method for decontaminating equipment is described comprising covering the contaminated surfaces with an aqueous 1 to 9N nitric acid solution, connecting the equipment as cathode into an electrolytic circuit and allowing electric current to flow until the desired contamination is achieved. The advantages claimed over conventional methods are that the period of time necessary is of the order of minutes rather than days or even weeks, and the amount of liquid that has to be handled is a small fraction of that required in conventional methods, so simplifying handling and disposal problems. (U.K.)

16297 RESEARCH ON RADIO CONTAMINATION IN HOKKAIDO. PART 7. SURVEY OF HIGHLY RADIOACTIVE FALL-OUT PARTICLES DUE TO THE THIRD NUCLEAR TEST BY PEOPLE'S REPUBLIC OF CHINA. Ando, Yoshiaki (Hokkaido Inst. of Public Health, Japan). Hokkaidoritsu Eisei Kenkyushoho, No. 17, 153-55(June 1967). (In Japanese).

Three types of high radioactivity particles were found on May 13 at Sapporo after the third nuclear test by People's Republic of China on May 9, 1966. Their radioactivities were determined and found to be not as high as those of particles found in Honshu district of Japan. One of the particles was photographed, showing a globular shape and a diameter of 7.6 μ. (NSA of Japan)

16298 ^{90}Sr AND ^{137}Cs IN SOYBEAN AND ITS PRODUCTS. Naoko, Takada; Ryushi, Ichikawa (National Inst. of Radiological Sciences, Chiba, Japan). Eiyo To Shokuryo, 20: 395-6(Jan. 1968). (In Japanese).

Analyses for ^{90}Sr and ^{137}Cs were carried out on soybeans and their products (soybean paste, fermented bean, bean curd, etc.) during 1961 through 1963. The content of these nuclides in soybeans reflected the geographical difference of radioactive fallout deposition to a considerable extent. The ^{90}Sr content did not change substantially during this period in spite of the remarkable increase of fallout rate in 1963, while ^{137}Cs content showed a clear increasing tendency from 1962 to 1963 because of its larger dependency upon current fallout rate than ^{90}Sr. The ^{90}Sr concentration relative to calcium (pCi/gCa) in soybean curd was remarkably lower than in any other foods of plant origin. (NSA of Japan)

16299 ESTIMATION OF LIFE-SPAN SHORTENING IN MAN EXPOSED WITH MAXIMUM PERMISSIBLE DOSE OF IONIZING RADIATION. Ueno, Yori (Kyoto Univ.). Hoken Butsuri, 3: 208-12(Mar. 1968).

On the basis of life span shortening data in irradiated mammals, life span shortening in man was estimated. A dose rate of 5 R per year was calculated from the maximum permissible dose for ages 18 to 60, and a dose rate of 0.2 R per day was calculated for ages 20 to 60. Using the value of 0.2 R per day, the life span shortening was estimated to be up to 4,070 days at age 60; using the value of 5 R per year, the life span shortening was estimated to be up to 1,690 days at age 60. Results suggested that effects of radiation on life span were related to age and that age 25 should be the minimum for exposure to radiation. (NSA of Japan) (TSS)

16300 INFLUENCE OF BONY TISSUE UPON DOSE DISTRIBUTION IN HIGH ENERGY ELECTRON BEAM THERAPY. Hattori, Hiroyuki; Kitagawa, Toshio (Aichi Cancer Center, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 27: 1457-62 (Feb. 1968). (In Japanese).

For evaluating effects of inhomogeneity of dose distribution caused by bone in high energy electron beam therapy, the absorption equivalent thickness (AET) of bone against water was studied. Bone specimens used were obtained from the pelvis, sternum and ribs of four cadavers who died of cancer at fifty to sixty years of age. The energy dependency of absorption difference between bone and water, examined using bone specimens described above, was practically negligible for the range of 16 to 31 MeV. The AET values were measured using 25 MeV electrons. The mean AET for nine specimens of which the mean density was 1.18 g/cm^3 was 1.14. Therefore, the effect of bone absorption on dose distribution is regarded as of less practical significance in electron-beam radiotherapy of the chest wall or pelvic region of cancer patients. (NSA of Japan)

16301 SKIN DOSES FROM A ^{60}Co TELETHERAPY UNIT. Shiragai, Akihiro; Noda, Hiroji (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 28: 68-71(Apr. 1968). (In Japanese).

In a lucite phantom, central axis percentage depth doses in the superficial layers from a ^{60}Co teletherapy unit were measured with lithium fluoride thermoluminescence dosimeter (TLD) and flat ionization chamber (FIC). The results measured with TLD were in good agreement with those obtained with FIC. At 60 to 90 cm S.S.D., skin doses increased with the increase of field size, but hardly varied within experimental error with S.S.D. although they tended to decrease a little. It was concluded that the disagree-

ments of skin doses among many reports may be due mainly to the differences of filter materials. (NSA of Japan)

16302 THYROID UPTAKE MEASUREMENT USING ^{125}I AND ^{131}I. Espinasse, P.; Chastanier, P.; Lahneche, B. (Univ. of Medicine and Pharmacy, Lyon). Phys. Med. Biol., 14: 27-37 (Jan. 1969).

Due to the low energy (27.4 keV) of the photons emitted by ^{125}I, the external measurement of thyroid activity requires a significant correction for tissue absorption. This correction can be determined by administering simultaneously a low dose of ^{131}I. A geometry-independent coefficient, R_{131}, is proposed, which is the ratio between the count rates measured over the patient's neck at 30 keV and at 364 keV. The exact correction for the absorption both of the 364 keV radiation from ^{131}I and the 27.4 keV radiation from ^{125}I can then be found; and the use of a phantom becomes unnecessary. The method can be used immediately for ^{131}I, but for ^{125}I it requires some technical improvements. Good agreement was obtained for uptake measurements of ^{131}I and ^{125}I in 13 double-tracer experiments. (auth) (UK)

16303 SAFE HANDLING OF RADIOISOTOPES AND RADIATION. Izawa, Masami (National Inst. of Radiological Sciences, Chiba, Japan); Kasamatsu, Tomomichi. Genshiryoku Kogyo, 14: No. 5, 11-42(May 1968). (In Japanese).

Radioisotopes and radiation are now being widely used for various purposes. Such uses have become fairly safe, due to advances in handling techniques. Still, the users must be fully aware of radiation protection needs. Problems, cautions to be taken, etc., are described in the following sections: safe handling for radioisotopes and radiation and some problems related to handling of radioactive materials, safe handling for radioisotopes, safe handling for sealed radiation sources and electron accelerators, safe handling for radiography sources and sealed sources for gauges, and safe handling for radioisotopes in hospitals. (NSA of Japan) (TSS)

16304 A PRACTICAL EXPRESSION OF ^{90}Sr AND ^{137}Cs CONCENTRATION IN SATSUMA ORANGE FRUIT. Shiraishi, Yoshiyuki; Okabayashi, Hiroyuki (National Inst. of Radiological Sciences, Chiba, Japan). Hoken Butsuri, 2: 173-8(Dec. 1967).

The distribution of radioactive fallout ^{90}Sr and ^{137}Cs absorbed into a Satsuma orange fruit was investigated. After peeling, the edible part of the fruit was divided into two parts by use of an autojuicer. One was juice, including interior cells of vesicle and a part of vesicle, the other was residue including the vesicle, vascular bundle and carpel wall. The ratio of ^{90}Sr concentration in juice to that in residue was found to be 3:7 while this ratio was 7:3 for ^{137}Cs concentration. When expressed in Sr units the values (266 to 422 pCi/g Ca) of the residue part were about six times as much as the juice part and about two to three times as much as the rind part. When expressed in Cs units the values (88 to 133 pCi/g K) of the rind part were about five times as much as the residue part or the juice part, and the residue and the juice part had almost the same value. For practical purposes, it is more convenient to express ^{90}Sr or ^{137}Cs concentration in orange fruit by content of the nuclide in juice per unit weight of fresh fruit than by the nuclide content per unit weight of edible part of fresh sample. (NSA of Japan) (TSS)

16305 INTERNAL RADIATION EXPOSURE. Koenig, L. A. (Kernforschungszentrums, Karlsruhe, Ger.). Atompraxis, 14: 467-70(Nov.-Dec. 1968). (In German).

On the basis of the ICRP publication 2 incorporation doses per μCi and per maximum permissible body burden are indicated for a number of radionuclides. The results, which should be taken as crude estimates only because of the simplicity of the model and the uncertainty of many basic data, show the requirement of direct measurement of the dose equivalent and the dose calculation, respectively, for the individual case. The often-used comparison of the measured results in terms of units of activity with the maximum permissible body burden expressed in units of activity in many cases does not permit a reliable judgement of an incorporation concerning the radiation exposure. (auth)

16306 PRESERVATION OF FOODSTUFFS: LEGAL ASPECTS OF IRRADIATION AND PROTECTION OF THE CONSUMER. Pomarola, H. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.), Suppl. No. 73, 7-11(Sept.-Oct. 1968). (In French).

The technical aspects of x radiopreservation of foods are reviewed. The French regulations particularly applicable to the treatment of foods by ionizing radiation and to control devices are cited. (J.S.R.)

16307 INDUSTRIAL HYGIENE PRACTICES GUIDE. LABORATORY HOOD VENTILATION. Amer. Ind. Hyg. Ass. J., 29: 611-17(Nov.-Dec. 1968).

This Guide was prepared by the Committee on Industrial Hygiene Practices from material contributed by H. J. Ettinger, M. W. First, and R. N. Mitchell. Supplementary information and comments were obtained from: R. S. Brief, J. H. Clarke, J. E. Peterson, and J. H. Rook. (auth)

16308 PRINCIPAL CONCEPTS AND QUANTITIES UTILIZED IN RADIOPROTECTION. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.), Suppl., No. 73, 20(Sept.-Oct. 1968). (In French).

The principal concepts and quantities used in industrial radioprotection are defined. These are ionizing radiation source, irradiation, exposure, exposure output, absorbed dose, dose equivalent, dose equivalent output, and recapitulation. (J.S.R.)

16309 THE DOUGLAS POINT AIR-SUPPLIED VAULT SUIT. Simmons, Robert B. V. (Atomic Energy of Canada Ltd., Sheridan Park, Ont.). Amer. Ind. Hyg. Ass. J., 29: 605-10(Nov.-Dec. 1968).

A requirement arose at the Douglas Point Nuclear Power Station for a protective suit which would permit inspection or maintenance work in a CO_2 atmosphere containing a high concentration of tritium and having high temperatures. Existing plastic clothing, while generally adequate for tritium, did not provide sufficient protection against the CO_2 hazard and did not provide a comfortable environment for detailed work. The suit consists of an inner cotton coverall and an outer plastic suit. It is air-cooled to permit work at temperatures up to 120°F and has a protective helmet containing a telephone communication system. An emergency air supply is provided. (auth)

16310 EXTERNAL RADIATION DOSES FROM OCCUPATIONAL EXPOSURE. Duggan, M. J.; Greenslade, E.; Jones, B. E. (Radiological Protection Service, Sutton, Eng.). Nature (London), 221: 831-3(Mar. 1, 1969).

Records accumulated between 1960 and 1965 of radiation doses received by a wide range of radiation workers in the United Kingdom are summarized. Doses were generally small. (auth)(UK)

16311 DETECTION OF ELEVATED FALLOUT LEVELS IN CALIFORNIA, JANUARY 1967. Cornish, Amasa C.; Uyesugi, George (California State Dept. of Public Health, Berkeley). Radiol. Health Data Rep., 9: 467-73(Sept. 1968).

California received a heavy fallout of radioactive debris beginning 4.5 days after a foreign nuclear device was detonated in the atmosphere on December 27, 1966. Highest air particulate levels occurred in Berkeley and Sacramento. Values obtained after allowing 3 days decay were 98 pCi/m^3 of air for both. Other air sampling stations had lesser amounts of fallout and Fresno received essentially no fallout. All milk-sheds in California were contaminated to some extent with radioactive iodine. Del Norte and Humboldt milk with 397 and 280 pCi/liter, respectively, contained the highest concentrations of iodine-131. These values were estimated to result in thyroid doses to children of 33 and 23 mrads, respectively. The apparent half-life for iodine-131 in the environment was calculated to be 3.2 days. (auth)

16312 A COMPARISON OF RESULTS BETWEEN THE PUBLIC HEALTH SERVICE RAW MILK AND PASTEURIZED MILK NETWORKS FOR JANUARY 1964 THROUGH JUNE 1966. Robinson, Paul B. (National Center for Radiological Health, Rockville, Md.). Radiol. Health Data Rep., 9: 475-88(Sept. 1968).

The Public Health Service Raw Milk and Pasteurized Milk Networks are compared for the interval January 1964 through June 1966 on the basis of milk sample analyses made during that period. Once laboratory effects owing to analytical differences in the milk sample analyses were removed from the data, the agreement for cesium-137 and strontium-90 between four of the nine stations that were common to both networks was related to milkshed overlap. At two other stations, Cincinnati and Chicago, homogeneity in the agricultural, geographical, and meteorological parameters accounted for the similarity between the sample concentrations of cesium-137 and strontium-90. It was not possible to study iodine-131, barium-140, or strontium-89 because the levels were generally not detectable for the period under study. A tabulation of data for all samples collected from the Raw Milk Network is also appended for the period, January 1963 to December 1966. (auth)

16313 DATA. Radiol. Health Data Rep., 9: 489-524(Sept. 1968).

Data from selected national, international, and state milk and food surveillance activities are presented. A table is presented to show average concentrations of ^{140}Ba, ^{137}Cs, ^{131}I, ^{89}Sr, and ^{90}Sr in pasteurized milk in the United States during 1967 and 1968. Concentrations of ^{137}Cs, ^{90}Sr, stable calcium and potassium in Canadian and Pan American milk during May 1968, are tabulated. Results of state milk surveillance activities are presented for California,

Oregon, and Washington during January through March 1968. (H.L.W.)

16314 ^{90}Sr IN SHED DECIDUOUS TEETH COLLECTED IN DENMARK, THE FAROES, AND GREENLAND FROM CHILDREN BORN IN 1950 TO 1958. Aarkrog, A. (Danish Atomic Energy Commission, Risoe). Health Phys., 15: 105-14(Aug. 1968).

Shed deciduous teeth were collected in 1962 to 1965 from 25 schools in Denmark, the Faroes, and Greenland. Approximately 10,000 teeth from children born in the period 1950 to 1958 were included in the investigation, which compiled 215 ^{90}Sr analyses. The ^{90}Sr level in deciduous teeth crowns increased by a factor of four from 1953 to 1958. Faroese teeth contained nearly 4 times as much ^{90}Sr as teeth from Denmark and Greenland. Incisors contained approximately three fourths of the level found in second molars. The ^{90}Sr diet levels measured in 1962 to 1966 in Denmark, the Faroes, and Greenland showed a similar variation between locations as the ^{90}Sr in deciduous teeth from children born in 1950 to 1958 in the same areas. The ^{90}Sr mean level in shed deciduous teeth is considered as an estimate of the ^{90}Sr content in the tooth donor's bone when 1 year old. (auth) (UK)

16315 EFFECTS OF URANIUM MILL WASTES ON STREAM BIOTA. Sigler, W. F. Utah State Univ., Agr. Exp. Sta., Bull., No. 462, 76(1966).

Waste waters from uranium mills contain radioactive substances. In the Animas river the radium activity was found to be 5 to 9 times above background in the water and up to 25 times the background level in the bottom deposits. Tissues of fish collected from the river contained 10 to 15 times the background levels of radium-226. Studies in the summer of 1958 showed complete absence of bottom fauna below the mill, and this pollution effect extended for 50 miles downstream. The amount of radium in the water and in the biota of the San Miguel and Dolores rivers was even higher than in the Animas river. It is stressed that waste waters from uranium mills should receive adequate treatment before discharge to prevent such pollution. (auth)

16316 PROTECTION FROM THE DAUGHTER PRODUCTS OF RADON THROUGH THE USE OF A POWERED AIR-PURIFYING RESPIRATOR. Burgess, Wm. A.; Shapiro, J. (Harvard School of Public Health, Boston). Health Phys., 15: 115-21(Aug. 1968).

The protection afforded by a powered air-purifying respirator against radon daughters was evaluated under physiological working conditions in air concentrations of daughter products in excess of 10^{-8} Ci/l. The tests demonstrated that this device could reduce the exposure to the radon daughters by factors of greater than 1000. Since the respirator filter did not remove the radon, the actual degree of protection afforded by the device in a radon-radon daughter atmosphere was evaluated. Several different methods for calculating dose were used and the results compared. It is suggested that a conservative protection factor of 20 be utilized for such devices until the critical regions of the lung affected by exposure to radioactivity in mines are identified. (auth)(UK)

16317 SAVANNAH RIVER EXPERIENCE WITH TRANSPLUTONIUM ELEMENTS. Moyer, R. A. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Contract AT(07-2)-1. Health Phys., 15: 133-8(Aug. 1968).

The Savannah River Laboratory is involved in research and development work with ^{244}Cm, ^{252}Cf, and other high-specific-activity alpha emitting isotopes. This work increases contamination problems and presents neutron and x-ray exposure problems not previously encountered. While problems of surface, air, and personnel contamination are similar to those with ^{239}Pu, the higher specific activity of the transplutonium isotopes increases the hazards and control problems, especially when finely divided dry powders are used. Containment is being achieved through design and strict procedures. Personnel exposure is being controlled and evaluated by using thermoluminescent dosimeters to supplement $\beta\gamma$ and NTA film badges. Because of the increased radiation the quantity of working material is limited and local shielding is used. (auth)(UK)

16318 IMPROVEMENTS IN OR RELATING TO RESPIRATORS. Fountain, Alec William; Morgan, David Gwynfor (to United Kingdom Atomic Energy Authority). British Patent 1,139,216. Jan. 8, 1969. Filed July 21, 1965.

With respirators for use in toxic atmospheres and incorporating non-return valves, operation is usually satisfactory so long as the inhalation and exhalation stages are smooth. If, however, the wearer coughs and inhales abruptly immediately afterwards, he may suck in toxic atmosphere because the valve has not properly returned to its seating. To reduce this risk a respirator has been designed comprising a resilient face-piece forming a gas-tight seal with the wearer's face, and in the face-piece is mounted a port with a non-return valve allowing egress of exhaled air to the atmosphere. On the exterior of the respirator there is a chamber covering this port and also having outlet ports to the atmosphere. A dome with peripheral ports is mounted over the non-return valve. An inwardly directed annular shielding wall is located between the outlet ports and the peripheral ports in the dome. The valve is thus in effect shielded from the external atmosphere by a series of baffles. If the wearer coughs, the valve is blown open and the exhaled air fills the exterior chamber (which has a capacity of about 6 cubic inches). If the wearer then inhales abruptly, a portion of the non-toxic inhaled air in the chamber returns and allows the valve to reseat itself. The series of baffles prevents direct ingress of heavy particles while the valve is unseated. (UK)

16319 INTAKE OF TRITIUM WHEN SKIN IS SPLASHED WITH TRITIATED WATER. Osborne, R. V. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Health Phys., 15: 155-6(Aug. 1968).

Where the skin is wet with tritiated water the intake rate per unit area is equal to that from a tritiated water vapour concentration saturating the air at the skin temperature. This intake rate per unit area may be only a few times that from air contamination if the local air space is hot and not well ventilated, since high heavy water humidities may be reached in such places. In these conditions the greater hazard may well be the air contamination. A calculation is given, which also takes into account the "blotter effect," illustrating this. (auth) (UK)

16320 SIMULTANEOUS ASSAY OF ^{226}Ra, ^{90}Sr, ^{137}Cs, AND ^{40}K IN HUMANS USING WHOLE BODY COUNTING. Bengtsson, L. G. Acta Universitatis Lundensis, Sectio II, No. 7, 1967. Lund, Sweden, C. W. K. Gleerup, 1967. 13p. Sw . Crs. 3.25.

Body burdens of radium and ^{90}Sr approximating the maximum permissible body burdens (100 nCi ^{226}Ra and 2000 nCi ^{90}Sr) were measured in presence of normal contents of ^{137}Cs and potassium. The content of the gamma ray emitting nuclide ^{241}Bi of the ^{226}Ra series could be assayed with an accuracy of about 10 percent. This accuracy was obtained from 2 hours measurement in scanning bed geometry using a ϕ 20 cm × 10 cm NaI(Tl) crystal. Further extension of the time of measurement would not have reduced the uncertainty much. For ^{90}Sr the accuracy was poorer (about 15 percent) among other things because of difficulties associated with excess 0.19 MeV gamma rays from ^{226}Ra in disequilibrium with its daughters. (auth) (Swed)

16321 LEVELS OF ^{55}Fe IN HUMANS, ANIMALS, AND FOOD, 1964-1967. Palmer, H. E. (Battelle-Northwest, Richland, Wash.); Langford, J. C.; Jenkins, C. E.; Beasley, T. M.; Aase, J. M. Radiol. Health Data Rep., 9: 387-90(Aug. 1968).

Iron-55 levels in the foods of humans have been decreasing since 1964 with the exception of caribou obtained from Arctic areas, which showed peak levels in 1965. The levels of iron-55 in humans at Richland, Wash., increased until about January 1967, and then began to decrease. This peak level in humans occurred about 4 years after the 1962 nuclear test series. This lag time of 4 years is much longer than that for cesium-137 in humans where peak levels occurred 1½ years after the nuclear tests stopped. (auth)

16322 ^{137}Cs LEVELS IN FLORIDA BEEF: VARIATIONS WITH FEEDING PROGRAM. Roessler, C. E.; Dunavant, B. G.; Bevis, H. A.; Roessler, G. S. (Univ. of Florida, Gainesville). Radiol. Health Data Rep., 9: 391-5(Aug. 1968).

Levels of cesium-137 in low quality lean beef samples, collected in the vicinity of Gainesville, Fla., in the spring of 1967, averaged 4,000 pCi/kg and ranged from 290 to 12,500 pCi/kg. The average and maximum levels in these samples from eight grass-fed animals were considerably higher than those in samples from 26 grain-fed animals from five peninsular Florida feedlots. The levels in the grass-fed animals suggest very high levels of cesium-137 intake by the animals, an extremely high feed-to-meat transfer, or both. For persons whose meat consumption is represented by the grass-fed animals examined in this study, it can be expected that meat exceeds all other commodities as the source of cesium-137 intake. (auth)

16323 THERMOLUMINESCENT RADIATION DOSIMETRY APPLIED TO DENTAL X-RAY EXPOSURES. Howley, John R.; Robbins, Charles; Dickinson, Mardalee B. (National Inst. of Health, Bethesda, Md.). Radiol. Health Data Rep., 9: 397-401 (Aug. 1968).

The glass-encapsulated thermoluminescent dosimetry system was found to be an effective method of conveniently measuring radiation exposure from dental and other diagnostic medical x-ray machines. It was found to overcome some of the important problems associated with the use of small ion chambers and film.

The TLD system was compared with the film dosimetry and the results were consistent except at very low exposures where film suffers from energy dependence in a scattered radiation field. It is apparent from the phantom measurements obtained that the patient radiation exposure is considerably less from the panoramic radiographic procedure than from the conventional full-mouth series. (auth)

16324 A PROCEDURE FOR EVALUATING ENVIRONMENTAL RADIATION DOSE TO CHILDREN IN THE VICINITY OF THE HANFORD PROJECT IN WASHINGTON, APRIL 1965-JANUARY 1967. Honstead, John F. (Battelle-Northwest, Richland, Wash.). Radiol. Health Data Rep., 9: 402-6(Aug. 1968).

The estimation of consumption levels and the population distribution of various consumption levels is being studied by Battelle-Northwest Laboratory. To obtain dietary data for a sample of the adult population, a diet form was prepared that is routinely presented to all people measured in the Hanford whole-body counters. Cooperation with the local school system was necessary for studying dietary levels of children. School children were asked to keep records of foods eaten and drunk during a consecutive seven-day period. Each child was counted for 10 min with the Hanford mobile whole-body counter. Data from diet record forms were analyzed and graphs are presented to show results. None of the more than 3,000 children measured in the whole-body counter had body burdens of radionuclides outside of the range anticipated on the basis of known environmental conditions. Nine phantoms for children ranging in size from 48 to 107 pounds were developed. Calibration factors were derived for zinc-65, potassium-40, cesium-137, and sodium-24. (H.L.W.)

16325 GAMMA-EMITTING FALLOUT IN SURFACE AIR AT FORT COLLINS, COLO., 1962-1967. Wilson, Daniel W.; Ward, Gerald M. (Colorado State Univ., Fort Collins). Contract AT(11-1)-1171. Radiol. Health Data Rep., 9: 407-11(Aug. 1968). (COO-1171-79).

Surface air gamma-ray activities of the fission products ^{144}Ce, ^{125}Sb, ^{106}Ru, ^{137}Cs, and a neutron activation product, ^{54}Mn, all from nuclear weapons testing, were measured at Fort Collins, Colorado, from 1962 to 1967. These measurements were part of a study of the transport of world-wide fallout from the atmosphere to milk. Of these radionuclides, only ^{137}Cs was observed regularly in milk, but there was some evidence of ^{54}Mn in milk. All of these radionuclides (with the addition of $^{95}Zr-Nb$) were identified in air, precipitation, and forages, and ^{144}Ce, ^{137}Cs, and ^{54}Mn were identified in animal tissue. In periods immediately following nuclear weapons tests, ^{131}I and $^{140}Ba-La$ were observed in forage and milk. Results are tabulated. (auth)

16326 ^{137}Cs IN MILK FROM THE COLORADO STATE UNIVERSITY DAIRY HERD, 1962-1967. Gallegos, Anthony F.; Ward, Gerald M. (Colorado State Univ., Fort Collins). Radiol. Health Data Rep., 9: 412-13(Aug. 1968).

Records of feed and fallout intake, milk production, and ^{137}Cs levels of milk were used to compare the relationships developed from closely controlled feeding experiments with smaller numbers of cows. Milk samples were obtained throughout the year from the composite milk output of the entire herd by sampling the bulk storage tank at the dairy farm. Feed consisted of stored alfalfa hay, mixed grain, and corn silage. The concentration of ^{137}Cs in milk increased through 1962 and reached a peak in the summer of 1963. The variation in milk from cows on pasture of fed green-cut alfalfa corresponded generally with seasonal trends in the direct fallout rate. Cesium-137 monthly averages in bulk and pasture milk are tabulated. (H.L.W.)

16327 DATA. Radiol. Health Data Rep., 9: 415-65(Aug. 1968).

Data from selected national, international, and state milk and food surveillance activities are presented. A table is presented to show average concentrations of ^{140}Ba, ^{137}Cs, ^{131}I, ^{89}Sr, and ^{90}Sr in pasteurized milk in the United States during 1967 and 1968. Concentrations of ^{137}Cs, ^{90}Sr, stable calcium and potassium in Canadian and Pan American milk during April, 1968, are tabulated. A table is presented to show ^{90}Sr to Ca ratios in milk in New York during January to December, 1967. (H.L.W.)

16328 ALPHA COUNTING BY LIQUID SCINTILLATION SPECTROMETRY: ^{239}Pu IN ANIMAL TISSUES. Lindenbaum, Arthur; Lund, Carol J. (Argonne National Lab., Ill.). Radiat. Res., 37: 131-40(Jan. 1969).

A liquid scintillation method was developed for the determination of microcurie and picocurie levels of plutonium-239 and other α-emitting radionuclides in animal tissues. A commercially available liquid scintillation spectrometer was used, and nearly 100% counting efficiency was achieved. Transfer losses and dilution of activity were avoided by preparation of the entire tissue sample, rather than an aliquot, in the counting vial to be used for the analysis. Organic matter was removed by alternating acid digestion with heating in a muffle furnace. Optimal ashing conditions and instrumental parameters were determined for the analysis of plutonium in bone, liver, spleen, feces, and urine. In several comparisons of analytical results by liquid scintillation and by proportional counting, close agreement between the two methods was obtained. However, the liquid scintillation method is less laborious and time-consuming, yields closer replication of analytical values, and permits more analyses per experiment, since tissues low in activity can be counted individually, rather than pooled. (auth)

16329 RADIATION HAZARD AND PROTECTION. Schinz, H. R.; Wideroe, R. pp 96-110 of Roentgen Diagnosis, 2nd American Edition, Vol. 1. Schinz, H. R. (ed.). New York, Grune and Stratton, 1968.

Certain characteristics of radiation and procedures useful for dose reduction in x and fluoroscopic irradiation are discussed briefly. High-kV techniques using tube voltages above 100 kV and greater filtration reduces the radiation exposure of the patient. In Germany, for voltages up to 125 kV, the use of a total filtration of 3 to 4 mm Al (or 0.2 mm Cu) is recommended, and for above 126 kV, 5 mm Al or 0.3 mm Cu. A film should never be overexposed and the developer should be fresh, since exhausted developer may require 30% higher exposure values. Double intensifying screens can reduce the exposure by a factor of 8. If the eye adaptation time is reduced from 25 to 6 min in fluoroscopy, the radiation exposure will be increased by a factor of 15 in order to obtain equally good perception. The image amplifier, in conjunction with television and electronic storage systems, may reduce radiation exposure of the patient by $\sim\frac{1}{2}$, and the adaptation time is eliminated completely. Large-field scout films often cannot be justified diagnostically and can lead to a large exposure of critical organs. The gonadal dose can be increased by a factor of 100 if the gonads are directly hit by primary radiation because, of a poorly focussed chest exposure. Examinations in the vicinity of critical organs (stomach, abdomen, pelvis, knee) must be limited in field size, and gonadal protection should be provided. For films of the pelvis of children, capsules should be used for the protection of testicles and ovaries. An apparently harmless x-ray dental examination can lead to a large gonadal dose if the field is not sufficiently coned and a Pb rubber apron is not used. (BBB) (TSS)

16330 THE CHALK RIVER NUCLEAR LABORATORIES RESPIRATOR PROGRAM. White, J. M.; Merrett, K. W. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Amer. Ind. Hyg. Ass. J., 29: 601-4(Nov.-Dec. 1968).

As a result of a study and recommendations made in early 1953, a protective equipment laboratory was constructed and staffed by well-trained personnel. The laboratory staff now services each month about 625 full facepiece, 460 oronasal, and 640 supplied-air respirators as well as 35 self-contained breathing apparatuses. Servicing is done routinely with specially designed tools and test equipment. The protective equipment laboratory staff tests and approves all respiratory equipment before purchase and issue. Proper fitting, sizing, and care of respirators is taught to all personnel who may be required to wear them. (auth)

16331 OCCUPATIONAL RADIATION DAMAGE TO THE EYE. Merte, Hanns-Juergen. Muenchen. Med. Wochenschr., 109: 501-4(Mar. 10, 1967). (In German).

The risk of occupational damage to the eye gains more and more in importance. Of these the opacities of the lens are the most significant ones; but also changes of the conjunctiva as well as cornea and eye-lids and possibly changes of the retina are not infrequently encountered. Inasmuch as these illnesses are not only relatively insignificant, transient illnesses, they are liable to indemnity according to the valid ordinance concerning occupational diseases. This particularly is applicable to cases of cataracts, provoked by heat rays or by ionizing rays. Work-hygienic precautions to protect the eyes from radiation effects must be demanded more than ever. Most of all, wearing of special glasses in addition to technical facilities to prevent damages is urgently required. (auth)

Medicine

Refer also to abstracts 16082, 16083, 16096, 16105, 16106, 16109, 16111, 16130, 16241, 16255, 16323, 16393, 16408, 16422, 16423, and 16428.

16332 (NIRS-7, pp 69-79) MEDICAL STUDIES. (National Inst. of Radiological Sciences, Chiba (Japan)).

Following intravenous administration of ^{131}I, metabolism of iodine in man was studied using mathematical models. Similar studies were conducted on ^{22}Na metabolism. A double tracer technique was used for studies on sodium metabolism in rats. Long-term effects of ^{131}I on thyroid function in rats were studied. A comparison was made between results of organ visualization by conventional integral scanning and those obtained with a differential scanning technique. Measurements of ^{40}K and ^{137}Cs were made in mothers, infants, and placentas. An improved ^{137}Ba m generator is described. A method for calculating dose distributions for ^{60}Co beam radiations with a digital computer is presented. Studies were made on clonal proliferation in bone marrow of irradiated humans. A radiological analysis of blood flow in the cortex and medulla of the kidney was made. (H.L.W.)

16333 EFFECTS OF IONIZING RADIATION ON THE RAT AT THE CELL, TISSUE, AND ORGAN LEVEL; PATHOLOGICAL CHANGES AND EFFECT OF RADIOPROTECTIVE AGENTS. de la Sierra Serrano, Daniel. Rev. Patronato Biol. Anim., 10: 31-49(Apr. 1966). (In Spanish).

Ten rats were given doses of 5,000, 1,500, and 750 rads of ^{137}Cs γ radiation. They developed symptoms and typical injuries of the acute irradiation syndrome; diarrhea, hemorrhages and denutrition. Survival experiments using cysteine for radiation protection were positive with doses of 1,900 mg/kg orally and 950 mg/kg parenterally. The experiments were not considered definitive because of the small group of animals and the limited range of doses of radiation. (auth)

16334 CHRONIC LYMPHOCYTIC LEUKEMIA IN HIROSHIMA AND NAGASAKI, JAPAN. Finch, Stuart C.; Hoshino, Takashi; Itoga, Takashi; Ichimaru, Michito; Ingram, Roland H. Jr. (Atomic Bomb Casualty Commission, Hiroshima. Atomic Bomb Casualty Commission, Nagasaki). Blood, 33: 79-86(Jan. 1969).

In Hiroshima and Nagasaki chronic lymphocytic leukemia is rare in comparison to the United States. No patient with this disorder was identified among the residents of Hiroshima City during a 20-year period of study. The incidence of chronic lymphocytic leukemia in Nagasaki City, however, was similar to that for all Japan. There is no evidence that the development of chronic lymphocytic leukemia in these cities was related to exposure to the atomic detonations of 1945. (auth)

16335 RADIOISOTOPES IN MALIGNANCIES IN CHILDREN. Tefft, Melvin (Children's Hospital Medical Center, Boston. Harvard Medical School, Boston). J. Amer. Med. Ass., 207: 1853-8(Mar. 10, 1969).

Of 1,500 children undergoing brain scanning, approximately 90% with low-grade cerebellar astrocytomas and 45% with medulloblastoma will have positive scans. In the supratentorial region, 85% to 90% of patients with highly malignant gliomas (grade 3 to 4), 15% to 20% of patients with low-grade gliomas (grade 1 to 2), 65% with optic glioma, and 30% with symptoms or signs, or both, of infiltration by acute leukemia, will have positive scans. Among 800 children having liver scans, primary lesions (hepatoma) were found in 100% of proven cases; and metastatic foci, in approximately 85% of those with proven liver metastases. The liver scan was useful in outlining liver volume for radiotherapeutic management. At routine liver scanning, a spleen scan was obtained to outline splenic cysts in 100% of children examined. With newer isotopes, scanning is applicable now as a routine method of survey in children. (auth)

16336 RADIOSENSITIZING ACTION OF AMETOHEPAZON AND THE IRRADIATED TUMOR TISSUES. 1. COMBINED THERAPY ON YOSHIDA SARCOMA. Tobe, Tatsuo; Niibe, Hideo (Gunma Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 27: 987-94(Nov. 1967). (In Japanese).

The radiosensitizing action of Ametohepazon (AH), a seven membered ring compound was studied on Yoshida ascites sarcoma transplanted intramuscularly into the femur of Donryu strain male rats weighing about 120 gm. The action was further investigated in vitro when mixed with Yoshida sarcoma cells. The results obtained are as follows. The radiosensitizing effect of AH combined with irradiation was observed following injection into the tumor, systemic administration, and in vitro experiments. No inhibitory effect was observed on the growth of tumor cells. The histological examination after topical injection of AH revealed edematous degeneration, cellular infiltration, softening necrosis and fibrosis, similar to the reaction to foreign bodies. In the early post-irradiation period, the topical administration was more effective than the systemic administration in inhibiting DNA synthesis. AH was effective when applied as late as 24 hours after irradiation, indicating a different mechanism from that of other radiosensitizers. Concerning the mechanism, although not known in detail, AH seems to impede either directly or indirectly the repair of tumor cells damaged by irradiation. (NSA of Japan)

16337 PHARMACOLOGICAL STUDIES ON CHEMICAL PROTECTORS AGAINST RADIATION. 4. STUDIES ON RADIOPROTECTIVE EFFECTS OF VITAMIN E AND ITS DERIVATIVES. Shinoda, Masato; Takagi, Yoshinari (National Inst. of Radiological Sciences, Chiba, Japan). Yakugaku Zasshi, 88: 278-82(Mar. 1968). (In Japanese).

The radioprotective activity of vitamin E and its esterified derivatives, using survival time and body weight changes in x-irradiated mice as the pharmacological indices was determined. Male mice of ddY strain, 5 to 6 weeks old, were used in this experiment. Each group consisting of 10 mice was exposed to 700 R whole body x-irradiation, which caused 100% mortality of the mice without medication within two weeks after x-irradiation under the condition adopted for this experiment. The test preparations such as vitamin E, and its acetate, ferulate, caffeate, and succinate were dissolved in sesame oil or cottonseed oil, or suspended in 5% Tween 80 aqueous solution, and administered intraperitoneally 24 or 3 hr before the irradiation or 5 min after irradiation; 1 mmole/kg of vitamin E, acetate or ferulate, 0.5 mmole/kg of the caffeate, or 0.25 mmole/kg of the succinate. The potency of radioprotective effect of each preparation was evaluated, based on the survival time up to 30 days and increase in body weight two weeks after irradiation, compared with the control. Tween 80, used as the detergent to emulsify the preparation, did not show any influence on survival time or body weight. Sesame oil was slightly radioprotective for survival time and body weight. Cottonseed oil caused decrease in body weight under certain circumstances. Under the condition of this experiment, vitamin E was slightly effective, the acetate was slightly effective, and the other esters were significantly effective, and it was found that the radioprotective effect was increased by esterification of vitamin E. It was also found that estimates of the effect based on survival time and on body weight were in agreement. The radioprotective effect of the preparations seemed to depend on the solvent used and the time of administration. (NSA of Japan)

16338 PHARMACOLOGICAL STUDIES ON CHEMICAL PROTECTORS AGAINST RADIATION. 3. RADIO-PROTECTIVE ACTIVITIES OF AET AND MEA AGAINST X-IRRADIATION. Shinoda, Masato; Oka, Takami (National Inst. of Radiological Sciences, Chiba, Japan). Yakugaku Zasshi, 88: 271-7(Mar. 1968). (In Japanese).

Potential effects of chemical radioprotectors, S-2-aminoethylisothiuronium bromide hydrobromide (AET) and 2-mercaptoethylamine (MEA), were tested by survival of ddY mice irradiated with a lethal dose of x rays, and characteristics of these compounds were comparatively examined. Both AET and MEA show comparatively acute toxicity and intraperitoneal injection of a lethal dose into mice results in their death within 24 hr. Comparison of the toxicity of AET and MEA, with consideration of their molecular weight, shows that the toxicity of AET is about twice as great. Optimal period of the administration of AET and MEA for effective appearance of their protective power is 5 to 30 minutes before irradiation, and both were ineffective if given after irradiation. Toxicity and protective action of AET do not change if it is converted to mercaptoethylguanidine (MEG) by adjusting its molar solution to pH 7.0 with sodium hydroxide. The protective effect of AET per aquecule is 2 to 4 times stronger than that of MEA. It was found that the protection of AET and MEA is not only effective against lethal action of x-ray irradiation but also markedly effective in protecting against weight loss. (NSA of Japan)

16339 A RAPID AND EFFICIENT METHOD OF PREPARING ^{99m}Tc-HUMAN SERUM ALBUMIN: ITS CLINICAL APPLICATIONS. Benjamin, Philip P. (Case Western Reserve Univ., Cleveland). Int. J. Appl. Radiat. Isotop., 20: 187-94(Mar. 1969).

An electrolytic method for the preparation of ^{99m}Tc-human serum albumin is presented. Transitional elements such as Zr and Fe appear to act as intermediate complexing agents for labeling proteins with technetium. Mercury also shows considerable promise. The reaction appears to be instantaneous and quantitative. Clinical application of this procedure is suggested. (auth) (UK)

16340 THE USE OF A RECENT ANTIBLASTIC DRUG METHYLHYDRAZINE ASSOCIATED WITH RADIOTHERAPY. Agati, G. (Univ. of Turin). Minerva Radiol., 13: 470-8(Sept. 1968). (In Italian).

Reference is made to a series of experimental and clinical researches on the antiblastic action of methylhydrazine and on its association with radiotherapy. The former revealed a definite antitumoral and radiosensitizing effectiveness in transplantable tumors. Clinical experimentation led to excellent results in lymphoreticular forms, particularly in malignant lymphogranuloma and lymphosarcoma. The response of the epithelial forms to exclusively chemotherapeutic treatment and

to chemo-radiotherapeutic association did not appear uniform. (auth)

16341 PROTECTION OF MICE AGAINST RADIATION INJURY BY PHENYLHYDRAZINE. Smith, L. H.; McKinley, T. W. Jr. (Oak Ridge National Lab., Tenn.). Proc. Soc. Exp. Biol. Med., 129: 702-5(Dec. 1968).

Radioprotection by phenylhydrazine was observed for mice exposed to 800 R of 250 kVp x rays. Maximum protection, as measured by 30-day survival, was achieved when mice were irradiated on day 5, 6, 7, or 8 after the third of 3 daily phenylhydrazine injections. It was postulated that improved survival resulted from an increase in the number of hemopoietic stem cells at the time of irradiation. (auth)

16342 THERAPEUTICAL POSSIBILITIES OF THE ISOTOPIC LYMPHOGRAPHY IN THE FEMALE GENITAL CARCINOMA. Vecchietti, G.; Onnis, A. (Univ., Padua). J. Radiol., Electrol., Med. Nucl., 49: 703-8(Oct. 1968). (In French).

This exploratory method permits a sufficient endo-lymphonodular irradiation with iodine-131 or phosphorus-32 in the zones the most frequently afflicted with metastasis. Oily ultrafluid contrast media are available for this investigation and they are infused through the lymphatic route according to an appropriate technique. It must be pointed out that the parametrial, pararectal, presacral and ovarian lymph-nodes chains escape irradiation more often. It is also true that they are less frequently involved (about 11% of the cases). The lymph-nodes more accessible to surgery are those that escape the isotopic lymphography. The most interesting finding is that isotopic lymphography allows also the detection of lymph-nodes harboring micro-metastasis. (auth) (C.O.)

16343 LUNG CARTOGRAPHY (FIRST RESULTS). Lahneche, B.; Verot, R.; Tran-Minh, V.; Dufoix, V.; Guichard, M. C. J. Radiol., Electrol., Med. Nucl., 49: 687-702(Oct. 1968). (In French).

Lung scanning after intravenous injection of serum albumin micro-aggregates labeled with ^{131}I constitutes a simple, totally painless and innocuous technique. The radiation dose received by the patient is low and allows eventual repetition of the investigation. The latter makes possible the study of lung circulation and is of high diagnostic value, particularly for confirming the presence of an embolism and for measuring the extent of devascularized territories. Information on extent is also obtained in the case of lung carcinoma. In the emphysemas, it constitutes a complement to the data of the functional respiratory tests and to the roentgenologic study. Scanning evaluates the effect of therapy in a number of diseases: embolism, lung carcinoma, superior vena cava syndrome, heart diseases. Nevertheless, there exist limits to the diagnostic possibilities of scanning, while the pathologic pictures noted are but assumed pictures. Scanning with mercury bichloride (^{197}Hg) has been found useful for the diagnosis of lung tumors, since carcinomas fix mercury in higher quantity than the healthy lung parenchyma. Comparison of cartograms obtained with intravenous iodine and isotopic aerosols (^{198}Au or technetium) permits visualizing parallel ventilation and circulation, a very useful element for a balance of lung diseases. (auth) (C.O.)

16344 USE OF THE LIVER SCAN IN THE TREATMENT OF HEPATIC ABSCESS. Stanford, William; Nielsen, Andrew A. (USAF Hospital, Lackland AFB, Tex.). Mil. Med., 134: 43-6 (Jan. 1969).

Instances of hepatic abscess in recent returnees from Southeast Asia causes us to review our experience at Wilford Hall USAF Hospital. In a recent ten year period, seven patients were treated. Liver scans proved to be the most consistently useful laboratory aid, and were helpful in the establishment of the diagnosis and in the follow-up of these patients. A brief comparison of the scanning agents currently in use is presented. (auth)

16345 BRAIN SCANNING IN CEREBRAL VASCULAR DISEASE. Tow, Donald E.; Wagner, Henry N. Jr.; DeLand, Frank H.; North, Wendy A. (Johns Hopkins Medical Institutions, Baltimore). J. Amer. Med. Ass., 207: 105-8(Jan. 6, 1969).

Forty-three patients with cerebral vascular accidents were divided into groups according to whether the available data and brain scans indicated cerebral hemorrhage or thrombosis and according to the intervals between scanning and onset of symptoms. There was a higher incidence of abnormal brain scans in patients with hemorrhage. The difference was most striking during the first week. During this period two of the four patients in the hemorrhagic group had abnormal brain scans, compared with only one of ten in the thrombotic group. A normal scan performed within the first week increased the probability of the diagnosis of cerebral thrombosis, since abnormal brain scans occur in about 80% to 90% of patients with brain tumors. A change in the appearance of the lesion over appropriate periods of time was more characteristic of vascular disease than of tumor. (auth)

16346 LIVER-COPPER LEVELS IN LIVER DISEASE: STUDIES USING NEUTRON ACTIVATION ANALYSIS. Smallwood, R. A.; Williams, H. A.; Rosenoer, V. M.; Sherlock, Sheila (Royal Free Hospital, London). Lancet, 2: 1310-13(Dec. 21, 1968).

Liver-copper concentrations were estimated in 95 patients with liver disease by neutron activation analysis of liver samples. The method is simple, sensitive, specific, and allows estimations to be made on very small needle-biopsy samples (2 to 3 mg). The normal range was found to be 15 to 55 μg copper per g dry liver. Levels of greater than 250 μg per g dry liver were found only in Wilson's disease and long-standing biliary obstruction, both intrahepatic (as in primary biliary cirrhosis) and extrahepatic. There was no diagnostic confusion between these two groups of patients, as those with biliary obstruction and high liver-copper levels had definite clinical and biochemical features of cholestasis. In patients with biliary obstruction the liver-copper level was related to the duration of symptoms. In other liver diseases, liver-copper levels were normal or moderately increased. (auth)

16347 TREATMENT OF THYROTOXICOSIS WITH IONISING RADIATION. Philp, J. R. (Univ. of Aberdeen, Scotland); Harrison, Michael T.; Ridley, E. F.; Crooks, J. Lancet, 2: 1307-10 (Dec. 21, 1968).

Because of the disadvantages of conventional treatment of thy thyrotoxicosis with ^{131}I, two alternative methods of radiation therapy were assessed. One group of patients received a dose of ^{131}I calculated to deliver 2400 rads to the thyroid, and a second group was treated by external radiation from a ^{60}Co source, with doses of 115 to 900 rads. In the patients treated by external radiation followed by antithyroid drug treatment, 25 out of the 28 patients relapsed soon after antithyroid drugs were withdrawn. It is concluded that there is no place for external irradiation in the treatment of thyrotoxicosis. Of the 30 patients treated with ^{131}I, only 11 were euthyroid two to three years later. Persistent hyperthyroidism, relapse, and hypothyroidism occurred in the remainder. It is, therefore, impossible to achieve a predictable "radiation partial thyroidetomy" with radioactive iodine, and doses sufficient to reduce thyroid function to normal will result in a significant risk of eventual thyroid failure. The best compromise seems to be that which attempts to postpone the development of thyroid failure beyond the patient's life expectancy. (auth)

16348 INFLUENCE OF SOME PHARMACOLOGICAL DRUGS WITH CENTRAL ACTION ON IRRADIATED MOUSE'S RESISTANCE AGAINST ASPHYXIA. Riotte, M.; Cier, A.; Maigrot, J. C.; Gleizes, J. (Faculte de Medecine, Lyon). Compt. Rend. Soc. Biol., 162: 938-40(Nov. 23, 1968). (In French).

The effect of pentetrazol, chlorpromazine, promethazine, and amphetamine on the resistance to asphyxia in irradiated mice was investigated. The mice were exposed to either 500 or 800 R. Irradiation at these doses always increases the survival of animals in a confined atmosphere. The results showed that the drugs also increased significantly the survival time. The drugs had an additive effect to the radiation effect with either agonistic or antagonistic reactions. (J.S.R.)

16349 EFFECT OF RADIOPROTECTORS IN ELECTRORETINOGRAPHY. Levy, J.; Dietz, P.; Kellershohn, C. (Faculte de Medecine, Paris). Compt. Rend. Soc. Biol., 162: 852-3(Nov. 23, 1968). (In French).

The possible role of free radicals in the mechanism of vision was studied by measuring the amplitude of the b wave of the electroretinogram in the rabbit after injection of cysteamine. The results showed a significant reduction of the b wave after the injection, followed by an increase to a level slightly below the initial amplitude. (J.S.R.)

16350 COMBINED RADIATION AND CHEMOTHERAPY. Raventos, Antolin. pp 58-64 of Current Perspectives in Cancer Therapy. Blakemore, William S.; Ravdin, I. S. (eds.). New York, Harper and Row, Publishers, 1966.

Recent attempts to improve effects of radiotherapy by combining it with chemotherapy are discussed briefly. Effects of irradiation alone are reviewed. Methods of altering sensitivity of tumors to radiation, including fractionation, use of hyperbaric O and drugs are described. Examples of adjuvant chemotherapy with triethylene melamine, actinomycin D, methotrexate, and cyclophosphamide are discussed, and relative merits and disadvantages of clinical trials are compared briefly with other

methods of screening chemotherapeutic agents used in radiotherapy. (BBB)

16351 CURRENT PERSPECTIVES IN CANCER THERAPY. Blakemore, William S.; Ravdin, I. S. (eds.). Current Perspectives in Surgery. New York, Harper and Row, Publishers, 1966. 247p. $8.50.

In addition to a brief discussion of effects of combined radiation and chemotherapy, subjects discussed include etiology and growth of tumors, hormones and chemotherapy, x-ray diagnosis of ulcerating gastric lesions including autoradiography, radiological examination of the colon, and chemotherapy of various tumors of children. (BBB)

16352 RADIATION INJURY. Penner, Ralph S. (Johns Hopkins Univ., Baltimore). pp 712-26 of The Management of Trauma. Ballinger II, Walter F.; Rutherford, Robert B.; Zuidema, George D. Philadelphia, W. B. Saunders Co., 1968.

The symptoms and clinical picture of the acute radiation syndrome, probable effects of exposure to doses of radiation from 25 to more than 5000 R, treatment and handling of patients exposed to irradiation and the externally contaminated patient, survey instruments used for personnel or area monitoring, methods of survey and decontamination of personnel, follow-up care of contaminated patients, and care of patients internally contaminated with radioisotopes are discussed. Radioisotopes that may be encountered in accidents, their major organs of deposition, maximum permissible body burden, and effective body retention times are tabulated. The use of medical records of radioisotope accidents, and installation planning are described briefly. Decontamination procedures for skin, wounds, equipment, and facilities are tabulated and detailed. (BBB)

16353 THE MANAGEMENT OF TRAUMA. Ballinger II, Walter F.; Rutherford, Robert B.; Zuidema, George D. (eds.). Philadelphia, W. B. Saunders Company. 1968. 826p.

A separate abstract was prepared for one chapter on radiation injury. Various aspects of traumatic injuries in addition to radiation injuries, including initial evaluation and treatment of the injured patient, pathophysiology of trauma and shock, treatment of shock, cardiopulmonary resuscitation and anesthesia in trauma, renal failure following trauma, injuries of the head and spinal cord, eye, lids, and orbits, emergency care of maxillofacial and neck injuries, tracheotomy, thoracic injuries, abdominal injuries, trauma of the genitourinary system, gynecologic injuries, injuries of the extremities and hands, initial management of fractures, prophylaxis and control of wound sepsis, management of burns, cold and electrical injuries, trauma in children, the role of the internist in trauma, psychological aspects of acute trauma, and mass casualty management are described and discussed in 22 additional chapters. (BBB)

16354 PROGRESS IN ATOMIC MEDICINE. NUCLEAR MEDICINE AND RECENT ADVANCES. VOLUME 2. Lawrence, John H. (ed.). New York, Grune and Stratton, 1968. 283p. $12.75.

Recent advances in applications of radionuclides to medicine are discussed and reviewed. These include: uses of radioisotopes for radioimmunoassays of various hormones in blood; use of short-lived radioisotopes for study of pulmonary and cardiac function; the possibility of studying regional blood flow in heart and lung disease and septal defects with ^{15}O and other radioisotopes; uses of positron-emitting radioisotopes to reduce radiation exposure; uses of ^{52}Fe and the scintillation camera to study bone marrow distribution in vivo; quantitation of red cell and heme production and destruction by radioisotope kinetics; theoretical developments and selected applications of radioisotopes; important factors in scanning procedures; dynamic scanning procedures based on recent computer and technical developments; progress in scanning of thyroid, brain, placenta, prostate, adrenal, blood circulation, eye, cerebrospinal fluid, choroid plexuses, salivary glands, lymph nodes, etc.; and physiological findings and problems in space medicine, where radioisotopes may prove to be useful. (BBB)

16355 IODOACETATE RESISTANCE AND IODOACETATE RADIOSENSITIZATION OF CONIDIA OF ASPERGILLUS NIDULANS. Georgopoulos, S. G.; Georgiadis, Eugenia (Democritus Nuclear Research Center, Athens). Radiat. Bot., 9: 69-73(Feb. 1969).

The conidia of a mutant of Aspergillus nidulans were found to exhibit a low degree of resistance to iodoacetic acid. The γ-radiation resistance of these conidia was similar to that of the wild type conidia. The two strains did not differ as to the effect of radiation in the presence of sensitizing concentrations of iodoacetate. (auth) (UK)

16356 EFFECT OF HEAVY WATER ON RADIOSENSITIVITY OF MAIZE AND BARLEY SEEDS. Gaur, B. K.; Joshi, R. K.; Notani, N. K. (Bhabha Atomic Research Centre, Trombay, India). Radiat. Bot., 9: 61-7(Feb. 1969).

Damage as a result of irradiation by sparsely ionizing radiation of maize and barley seeds was found to be lower when dry seeds were soaked in D_2O than in H_2O prior to irradiation. The reduction in radiosensitivity by D_2O was mainly manifested in the presence of oxygen, there being no effect of D_2O when seeds were irradiated anaerobically. Evidently, the reduction in radiation damage due to D_2O is largely oxygen-dependent. (auth) (UK)

16357 KERNTECHNIK IN DER MEDIZIN. (Nuclear Engineering in Medicine). Scheer, Kurt E. (ed.). Thiemig-Taschenbuecher. Band 33. Munich, Verlag Karl Thiemig KG, 1968. 159p. DM 9.80.

Eleven chapters are presented that consist of a discussion, outline, evaluation, or review of the following topics: the design and performance of the Anger camera, the positron camera, the digital autofluoroscope, the image-intensifier camera, and the spark camera, as well as their characteristics and developmental possibilities; localization of pathologic processes with radioisotope-labeled substances and the practical performance of the methods and their medical interpretation; methods for using radioisotopes and tracer techniques for diagnostic, physiological, or therapeutic purposes in hematology; clinical function diagnosis using I and Fe tracer techniques; the use of 4π large-volume radiation detectors with liquid organic scintillators in research and diagnosis of absorption and metabolism in man; the requirements a radioisotope must meet to be used as the radiation source in telegamma therapy (^{137}Cs and ^{60}Co); physical data, methods of application and indications of radioisotopes that can be used as enclosed radiation sources for local application; therapeutic uses of ^{131}I, ^{32}P, and ^{198}Au; circumstances that warrant use of betatron therapy; the importance of nuclear reactors and particle accelerators to medicine; and determination of the radiation dose delivered to the entire body, the critical organ, and the gonads following the diagnostic use of radioisotopes. (C.O.)

16358 PREVENTION OF RADIATION DAMAGE. Llorens, Alfred S.; Graham, Ruth M. (State Univ. of New York, Buffalo). Surg. Forum, 19: 400-1(Oct. 1968).

From Conference on Fundamental Surgical Problems, Chicago, Ill. See CONF-681036.

It has been found previously that radiation damage is associated with increased numbers of mast cells containing 5-hydroxytryptamine and histamine. In this study, mice were fed full synthetic diets and diets devoid of histidine and/or tryptophan, the precursors of 5-HT and histamine. Four weeks after beginning the diet, the mouse tails were irradiated at 4,000 or 8,000 R. Fourteen days later, the mice on the full synthetic diet showed gross evidence of radiation injuries to the tails, while the mice on the deficient diet showed no reaction during the 50 days of observation. Over half of the mice on deficient diets had died of anesthesia or malnutrition within two weeks after irradiation. (C.O.)

16359 SIGNIFICANCE AND MECHANISM OF THE INDIRECT EFFECT IN BACTERIAL CELLS. THE RELATIVE PROTECTIVE EFFECT OF ADDED COMPOUNDS IN ESCHERICHIA COLI B, IRRADIATED IN LIQUID AND IN FROZEN SUSPENSION. Sanner, Tore; Pihl, Alexander (Norwegian Radium Hospital, Oslo). Radiat. Res., 37: 216-27(Jan. 1969).

The sensitivity of Escherichia coli B to x rays, in the presence and in the absence of added compounds, was studied at different irradiation temperatures in the range 0° to −196°C. All irradiations were carried out under anoxic conditions. The radiosensitivity was reduced by approximately 50% when the irradiation temperature was reduced from 0° to −15°C. Concomitantly, the protective action of ethanol disappeared almost completely. Glycylglycine, which offered no protection at 0°C, gave increasing protection at decreasing irradiation temperatures. The protection of E. coli B at 0°C increased with increasing ability of the compounds to react with OH radicals. No correlation was found between protective ability and rate of interaction with e_{aq}^-. The results indicated that, under anoxic conditions, the portion of the indirect effect in E. coli B that could be abolished by freezing or high concentrations of radical scavengers contributed approximately 50% to the lethal damage and that the indirect effect was due to the action of OH radicals. The protection to be expected at 0°C by different concentrations of ethanol was calculated with the aid of the reaction kinetics. The calculated results were in good agreement with those observed. The diffusion length of the OH radicals involved in the destruction of the target molecules was calculated to be about 25 Å. None of the compounds tested protected to a greater extent than could be predicted from their ability to scavenge OH radicals. (auth)

16360 BALNEOTHERAPY OF RADIATION INJURIES. (PART 24). RESULTS IN THE RESEARCH INSTITUTE OF ATOMIC BOMB SURVIVORS UTILIZATION OF BEPPU HOT SPRING. Hatta, Osamu (Kyushu Univ., Japan). Oita-ken Onsen Chosa Kenkyu-kai Hokoku, [No. 19], 4-9(Mar. 1968). (In Japanese).

Continuing from the last report, the results are given of the hot spring cure on the visitors to this hot spring laboratory for the year beginning April 1967 to March 1968. Number of users were 1,375 and they were 43 on an average through the year. Pass limits of the cure were the same as the last time, i.e., number of erythrocyte, 3,000,000 to 5,000,000/mm^3, hemoglobin amount 75 to 95%, number of leukocyte 5,000 to 8,000/mm^3, the systolic pressure 100 to 150 mm Hg, albumin in urine negative, sugar in urine, urine urobilinogen normal, Davis inspection neg. Inspection results of the visitors before and after the cure were compared with the above pass limits and the cases whose results were worse than the limits were expressed as the percentage bearing to the total number inspected. The cases of the abnormal leukocyte and systolic pressure before the cure were conspicuous. Oligochromemia, leukocytosis, abnormal urobilinogen in urine were improved by the cure. It was also effective for the abnormal systolic pressure, but gave no influence for the abnormal sugar value in urine. Judging from the above results, the effects of the cure were almost the same as the former report and they were conspicuous especially in leukocytosis and abnormal systolic pressure. The functions of adrenal and pituitary-adrenal were improved by the cure. (NSA of Japan)

16361 BALNEOTHERAPY OF RADIATION INJURIES. (20). THE EFFECT OF NEUTRON IRRADIATION ON SMALL ANIMALS AND ITS HOT-SPRING CURE (AN INTERIM REPORT). Hatta, Osamu; Toyonaga, Teru (Kyushu Univ., Japan). Oita-ken Onsen Chosa Hokoku-syo, No. 17, 1-5(Mar. 1966). (In Japanese).

Mice were irradiated with neutrons at doses of 600 to 700 rad and changes of their body weight, hemoglobin amount, erythrocyte count and leukocyte count were studied. Further, these mice were subjected to three kinds of hot-spring bath (A-bomb Center hot-spring, Balneotherapy Research Institute hot-spring and Yanagiyu hot-spring) or fresh water bath for 10 minutes a day, and the effect of these hot springs was investigated. The results obtained are as follows: In the control group taking no bath, the body weight decreased 5 to 6 days after irradiation with a valley in its curve, and therefore it gradually increased. Of the bathing groups, the groups subjected to Yanagiyu and Balneotherapy Research Institute hot-spring bath did not show the valley, indicating that these two hot springs were effective in preventing the body weight loss. In both the control and bathing groups, no significant change was observed in the hemoglobin amount and erythrocyte count. In all the groups, the leukocyte count was markedly decreased immediately after irradiation. In the control and fresh-water bathing groups, the recovery of leukocyte count was extremely delayed, and the count remained 30 to 40% of the preirradiative count even at the 16th day after irradiation. In the group subjected to Balneotherapy Research Institute hot-spring bath, its recovery was slow, with a decrease of 50% at the 16th day, and in the groups subjected to A-bomb Center and Yanagiyu hot-spring bath, it recovered rapidly, with a decrease of less than 20% at the 14th day after irradiation. (NSA of Japan)

16362 HOT SPRING THERAPY FOR RADIATION INJURY. (23). EXPERIMENTAL OBSERVATION ON THE EFFECT OF HOT SPRING THERAPY ON NEUTRON AND γ-RAY INJURIES. Hatta, Osamu; Arima, Masashi (Kyushu Univ., Japan). Oitaken Onsen Chosa Kenkyu-kai Hokoku, No. 19, 1-3(Mar. 1968). (In Japanese).

Mice (ddN pure line weighing 20 to 24 g) were subjected to mixed ^{137}Cs γ and neutron irradiation, and then to hot spring therapy for twenty days. The irradiation consisted of a rotatory-neutron-radiation treatment of 200 rad, during which, 300 rad of γ-radiation was also given 15 minutes after the initiation of treatment. The hot spring therapy began the next day, continuing for 20 days. Five different hot springs were used; A-Bomb Center, Yanagi and Umijigoku hot springs, a modified hot spring (Co 1.67 mg/kg and colloidal S 2mg/kg added to the waters from the hot spring of this laboratory) and a salt-free hot spring. During therapy, the leukocyte, erythrocyte and reticulocyte counts, and the body weights of the mice were recorded regularly, as well as the hemoglobin values and the general blood picture. Mice suffering from nearly fatal (50% lethal dose) injuries showed sufficient signs of recovery only after three weeks. When various hot springs were combined in the therapy, the erythrocyte counts and body weights began to recover after two weeks with the exception at Umijigoku hot spring where the health of the mice worsened. Generally, the modified hot spring and the one at the A-Bomb Center were most effective while the one at Umijigoku was the worst, checking only the decrease of the erythrocyte count. (TSS) (NSA of Japan)

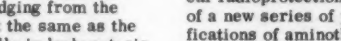
16363 QUESTION OF THE ADVISABILITY OF ISOTOPE PLACENTOGRAPHY AND ISOTOPE TESTS ON INFANTS AND CHILDREN. Gefferth, Karoly (Medical Univ., Budapest). Orv. Hetil., 109: 2762-3(Dec. 15, 1968). (In Hungarian).

The procedures used to determine the location of the placenta and the field of isotope application during infancy and childhood are reviewed. The conclusion is reached that, under certain conditions, isotope tests can be allowed in both fields but only on the basis of very stringent indication and only in institutes equipped for such tests on children. Isotope tests may be carried out or are indicated in cases in which no other procedure can furnish the diagnosis and when the x ray examination that could be substituted for it would produce a greater load of irradiation than the isotope test. (35 references) (JPRS)

16364 RADIATION PROTECTIVE COMPOUNDS: HETEROARYL ETHERS OF 2-HYDROXYETHYL-2-MERCAPTOETHYLAMINE AND THEIR DERIVATIVES. Gericke, Wolfgang. Urbana, Ill., Univ. of Illinois, 1968. 199p.

Thesis.

Based on the hypotheses presented for the mechanism of chemical radioprotection, several criteria were combined for the design of a new series of potential antiradiation drugs. Structural modifications of aminothiols were prepared with a β-mercaptoethylamine moiety representing the active pharmacophoric grouping and in which a secondary amino group of the cysteamine portion was separated from a heteroaryloxy system by two carbon atoms, as depicted in the following general formula:



where (R = a heteroaromatic ring and Y = $-SH$; $-S-SO_3H$.) A decisive reason for incorporating a heterocyclic ring system was based on the findings that certain chemical compounds having maximum absorption in the ultraviolet region of the spectrum can absorb quanta of ultraviolet radiations formed during the action of ionizing radiation on the body. Combining the conventional radioprotective cysteamine grouping with this capacity to "trap" radiation energy could result in an increased potency of the drug. Replacing the thiol group in the amino thiols by a thiosulfate group resulted in a decreased toxicity. Precursors for the preparation of the title compounds were obtained by synthesizing heteroaryl ethers of 2-hydroxyethylamine and of N-(2-hydroxyethyl)ethylenimine. The key step involved α- or γ-haloheterocyclic compounds; these halogen atoms are particularly prone toward nucleophilic displacement and were replaced by 2-aminoethoxide and the alkoxide of N-(2-hydroxyethyl)ethylenimine. A number of aminoethoxyheterocyclic compounds with an intact primary amine function were synthesized as well as heteroaryl ethers of N-(2-hydroxyethyl)ethylenimine having the formula,

where R = a heteroaromatic ring, R′, R″ = H; $-CH_2-CH_2-$. Various routes for the synthesis of heteroaryl ethers of 2-hydroxyethyl-2-mercaptoethylamine were investigated. The best procedure to form functionalized N-substituted cysteamines was found to be the reaction of ethylenimine derivatives with hydrogen sulfide. The most elegant method for the synthesis of 2-hydroxyethyl-2-S-thiosulfuroethylamine (Bunte salts) involves the use of ammonium thiosulfate for the cleavage of aziridines. Of those compounds submitted for antiradiation screening, the test data of only a few are available. The mice were tested for 30-day survival against fully lethal radiation of 825 R from an x ray source. In spite of the paucity of the data the striking protective activity of 2-(2-quinolyloxy)ethyl-2-S-thiosulfuroethylamine is significant: complete protection (100% survival) was achieved at a dose level of 180 mg/kg, while its LD_{50} was 320 mg/kg. (Disser. Abstr.)

Radiation Effects on Animals

16365 (JPRS-47249) SPACE BIOLOGY AND MEDICINE, VOL. 2, NO. 5, 1968. Translation of Kosm. Biol. Med., 2: No. 5, 3-96(1968). 143p. CFSTI.

Papers within the scope of NSA were abstracted from the original language and have appeared in previous issues. (C.O.)

16366 EFFECT OF TOTAL ROENTGEN RADIATION ON MICROSCOPIC AND SUBMICROSCOPIC STRUCTURES OF STOMACH. Tkachenko, Z. Ya. (Inst. of Physiology, Kiev). Fiziol. Zh., Akad. Nauk Ukr. RSR, 14: 803-11(Nov.-Dec. 1968). (In Ukrainian).

The reaction of the intramural nervous apparatus of rabbits' stomach to total radiation at a dose of 300 rad was observed. An hour after beginning the experiment, changes are discovered

by means of the neurohistological and electronoscopical methods. These changes increased with time and were maximum on the 5 th to 10 th days after irradiation. However, the reactive and dystrophic processes involving considerable part of the nerve structures of plexes, led to the destruction of a small amount of the nerve cells and fibers. A part of the nerve elements was without deviations from the norm. Besides the regressive changes, other observations included proliferation of glia, growth of new dendrites of the nerve cells, growth of the lateral processes of the dendrites, growth of short nerve fibrils, and normalization of the ultrastructures. (auth) (C.O.)

16367 SURGICAL FORUM. VOLUME XIX. Proceedings of the 24th Annual Sessions of the Forum on Fundamental Surgical Problems, 54th Clinical Congress of the American College of Surgeons, Chicago, Illinois, October, 1968. Surg. Forum, 19: 1-551(Oct. 1968). (CONF-681036).

Separate abstracts were prepared for four papers. Each represents only a part of its respective section on cardiac problems, gynecology and obstetrics, plastic surgery, and tumors. In addition, the conference covered 13 additional areas. (C.O.)

For abstracts of individual papers see: 16358 and 16418–16420.

16368 THE OXYGEN EFFECT AND X-RAY SENSITIVITY IN SYNCHRONOUSLY DIVIDING CULTURES OF CHINESE HAMSTER CELLS. Legrys, Geoffrey A.; Hall, Eric J. (Churchill Hospital, Oxford). Radiat. Res., 37: 161-72(Jan. 1969).

Hydroxyurea was used to produce a synchronously dividing population of Chinese hamster cells. The x-ray sensitivity was measured under aerated and hypoxic conditions as a function of stage in the generation cycle. The pattern of response to a single dose of 800 rads in air or 2000 rads under hypoxia was very similar, implying no significant change in the oxygen enhancement ratio with stage in the generation cycle. Full dose-survival curves under aerated and hypoxic conditions were obtained for cells in mitosis and for cells in the DNA synthetic period. These stages in the cycle represent the extremes of radiosensitivity; the survival curves differed principally in extrapolation number rather than slope. Cells in both of these stages of the generation cycle exhibited an oxygen enhancement ratio close to 2.6. (auth)

16369 A DETAILED ANALYSIS OF X-RAY-INDUCED PROPHASE DELAY AND REVERSION OF GRASSHOPPER NEUROBLASTS IN CULTURE. Carlson, J. Gordon (Univ. of Tennessee, Knoxville). Contract AT-(40-1)-2575. Radiat. Res., 37: 1-14(Jan. 1969).

Effects of x-ray exposures of 8, 16, 32, 64, 128, 512, and 1024 R on mitosis in hanging-drop preparations were determined by repeated observations of selected prophase cells before and at short intervals after irradiation. Prophase was subdivided into eight microscopically distinguishable stages: very-early, early, initial-middle, intermediate-middle, terminal-middle, initial-late, intermediate-late, and terminal-late. With one exception, cells treated at intermediate- or terminal-late prophase with any of the doses were neither delayed nor reverted. After 8 to 16 R nearly all cells from early to initial-late prophase were delayed in reaching prometaphase, but none reverted. After 32 to 64 R all cells in early to initial-late prophase were delayed and most reverted; after 128 to 1024 R nearly all reverted. Delay or reversion was preceded by a postirradiation inertia, during which the cell progressed mitotically at an almost normal rate for a short time. Duration of inertia was inversely related to dose. The degree of reversion depended on the exposure; at 128 R and greater, all cells that reverted went back to early prophase. The relations of the G_1, S, and G_2 periods of the mammalian cells to the morphologically defined stages of the cell cycle of the acridian neuroblast were considered. (auth)

16370 X-RAY-INDUCED PROPHASE DELAY AND REVERSION OF SELECTED CELLS IN CERTAIN AVIAN AND MAMMALIAN TISSUES IN CULTURE. Carlson, J. Gordon (Univ., Heidelberg. Univ. of Tennessee, Knoxville). Contract AT-(40-1)-2575. Radiat. Res., 37: 15-30(Jan. 1969).

Effects of x-ray exposures ranging from 32 to 1024 R on mitosis in chick, mouse, and rat fibroblasts, mouse mammary carcinoma (LH5), Walker rat carcinoma-sarcoma 256, and human carcinomas of the larynx (H. Ep. No. 2) and cervix (HeLa) were determined by repeated observations of selected prophase cells at short intervals after irradiation. Prophase reversion was detected in all cell types except HeLa. It was preceded by a postirradiation inertia during which the cell continued its forward progress for a few minutes. Duration of inertia was inversely related to dose. Cells whose inertia carried them into terminal-middle prophase might revert but not if it carried them into late prophase. There was a positive correlation between the percentage of cells x-irradiated at middle prophase that reverted and the normal duration of middle prophase in that tissue. The percentage of cells that reverted when treated at early prophase tended to be smaller for cell types with shorter early + middle prophase duration. The percentage of middle prophase cells that reverted was small compared with the percentage of early prophase cells for each type of tissue. Reversion of cells exposed at interphase occurred but was detectable only if postirradiation inertia carried the cell into prophase. The relation of morphologically defined mitotic stages to the DNA synthetic cycle of the acridian neuroblast, chick fibroblast, and mouse mammary carcinoma cell is described. (auth)

16371 RADIATION-INDUCED EFFLUX OF INTRACELLULAR POTASSIUM. Dawson, K. B.; Seymour, R.; Mutton, D. E. (Royal Marsden Hospital, Sutton, Eng.). Radiat. Res., 37: 83-9(Jan. 1969).

Irradiation of the isolated frog sciatic nerve previously equilibrated in a solution containing ^{42}K with doses of 10 to 20 krads at a dose rate of 15 krads/min caused an increased efflux of ^{42}K associated with the period of irradiation. This result, together with previously published findings, demonstrated that irradiation at a sufficiently high dose rate caused an increased permeability of the axonal membrane and a net loss of potassium ions. Analogous experiments with cultured tumor cells showed that in this case there was no net loss of potassium after doses up to 230 krads at 65 krads/min, but there was a much greater rate of exchange of intra- and extracellular potassium ions without any obvious damage to the cell membrane in the first six hours after irradiation. (auth)

16372 THE EFFECT OF 2,4-DINITROPHENOL ON THE REPAIR OF RADIATION INJURY BY L CELLS. Dalrymple, Glenn V.; Sanders, J. L.; Baker, Max L.; Wilkinson, K. P. (Univ. of Arkansas, Little Rock. Veterans Administration Hospital, Little Rock, Ark.). Radiat. Res., 37: 90-102(Jan. 1969).

The uncoupler of aerobic oxidative phosphorylation, 2,4-dinitrophenol (DNP), was previously shown to decrease the radiosensitivity of L cells. Here paired irradiation experiments with DNP-treated cells were performed. Although DNP treatment virtually stops macromolecular synthesis, the paired-dose survival curve showed a definite repair segment. The absolute survival reached by the DNP-treated cells was greater than that in parallel irradiated control cells kept in complete growth medium. (auth)

16373 ULTRASOFT X RAYS. An Historical and Critical Review of the World Experience with Grenz Rays and Other X Rays of Long Wavelength. Hollander, Mark B. Baltimore, The Williams and Wilkins Company, 1968. 206p. $30.00.

Physical considerations in grenz rays, human skin, and grenz-ray dosimetry are discussed. The effects on human skin are considered in detail: erythema, histology, sensitivity, and sequelae. The mechanism of action of ionizing radiation is discussed and the use of grenz rays in therapy of skin diseases is outlined and evaluated in detail. (418 references) (C.O.)

Invertebrates

Refer also to abstracts 16265 and 16273.

16374 (AD-668330) INHIBITION OF REGENERATION OF PLANARIA BY MIDLETHAL EXPOSURES TO X RAYS. Kendall, Kathleen; Nachtwey, D. Stuart (Naval Radiological Defense Lab., San Francisco, Calif.). May 8, 1968. 24p. (USNRDL-TR-68-29). CFSTI.

The results of studies on the radiosensitivity of the planarian worm, Dugesis dorotocephala, and on the effect of x-rays on the capacity to regenerate after decapitation are reported. The LD50/60 of intact worms is 1303 R (95% confidence interval 1198-1408 R). The mean survival time is 33.7 days. Worms decapitated immediately after exposures ranging from 200 to 1600 R regenerate normally even if they die later. Worms decapitated 9 days after exposures to 200 or 400 R, regenerate normally, whereas, after exposures to 800 or 1600 R, they do not. In an experiment in which worms were exposed to 800 R and then decapitated at various times from 1 hour to 55 days after irradiation, it was shown that worms lose and then regain the capacity to regenerate: the curve representing the capacity for normal regeneration as a function of time after irradiation (percentage of worms regenerating normally after being decapitated at various times) falls from 100% at 1 hour to 50% at 3 days to 0% at 7 days. Recovery of capacity starts at 10–14 days and is 50% complete by about day 20 and essentially complete by about day 30. The phenomenon described may prove useful in studies of the relationship between cell population kinetics and recovery from sublethal radiation damage. (auth) (USGRDR)

16375 (ORNL-TM-2311) HABROBRACON EXPERIMENT P-1079. Quarterly Progress Report to the National Aeronautics and Space Administration, July 1–September 30, 1967. von Borstel, R. C. (Oak Ridge National Lab., Tenn.). Nov. 1968. Contract W-7405-eng-26. 95p. Dep. CFSTI.

Dosimetry tests, walk-through, and Gantry tests are reported along with other pre-flight activities associated with the Biosatellite II flight, particularly the Habrobracon experiment hardware and trial runs associated with the flight. Ground-based duplicates of the inflight Habrobracon experimental setup were maintained. All insects in both setups survived during the period of experimentation with the inflight males demonstrating disorientation that interfered with normal mating. Dosimetry tests post-flight indicated that the ^{89}Sr γ-source holder for irradiating the inflight insects had been drastically altered. (E.R.B.)

16376 (ORNL-TM-2312) HABROBRACON EXPERIMENT P-1079. Quarterly Progress Report to the National Aeronautics and Space Administration, October 1–December 31, 1967. von Borstel, R. C. (Oak Ridge National Lab., Tenn.). Nov. 1968. Contract W-7405-eng-26. 102p. Dep. CFSTI.

The post-flight evaluation of the Habrobracon experiments conducted during the flight of Biosatellite II are presented. The γ irradiation experiments, both on board and ground-based, were analyzed to determine the effects of inflight γ irradiation on the incidence of dominant lethality, recessive lethality, and partial sterility in male Habrobracon; and total dominant and recessive lethality induced during oogenesis and oogonial billing and dominant lethality in the females. Although data are not yet completely analyzed, indications are that all insects survived the flight; males were disoriented in mating behavior following flight; no differences appeared to exist between inflight and ground-based irradiated sperm; sterility data are still being analyzed; and flight conditions appeared to enhance γ-radioinduced lethality in metaphase I oocytes with oocytes in general showing a space-flight effect on radiosensitivity. Possible mechanisms for differences between ground-based and inflight data are discussed. Although males that were γ-irradiated inflight showed disorientations in mating behavior, their sperm had an enhanced fertilizing capacity. A computer program was written to handle the large amount of data from the Habrobracon experiment. The older program was revised to include computation of primary and secondary sex ratios and to compute confidence limits. In relation to the dominant lethality frequencies, no differences were observed between ground-based and inflight irradiated groups. (E.R.B.)

16377 EFFECT OF PROTECTION AGAINST NATURAL IRRADIATION IN PARAMECIUM AURELIA AFTER AUTOGAMY. Planel, H.; Soleilhavoup, J. P.; Tixador, R.; Caratero, C. (Faculte de Medecine, Toulouse). Compt. Rend. Soc. Biol., 162: 990–5 (Nov. 23, 1968). (In French).

The effect of natural irradiation on post-autogamic cultures of Paramecium aurelia was studied; an investigation was made to verify if comparable results were found in stock cultures developed without previous autogamy. The results show that natural ionizing radiations favor the multiplication of Paramecium aurelia: a decrease of ionization is shown by a reduction of their multiplication capacity. This phenomenon was observed both for stock cultures and for cultures composed of homozygous organisms. (tr-auth)

Vertebrates

Refer also to abstracts 16220, 16223, 16225, 16227, 16231, 16234, 16240, 16262, 16333, 16337, 16338, 16341, 16348, 16358, 16361, 16362, and 16364.

16378 (AD-660580) IMMEDIATE BEHAVIORAL DETECTION OF X RAYS BY THE RHESUS MONKEY. Final Report, July 1967. Taylor, Henry L.; Smith, James C.; Hatfield, C. Ann (Florida State Univ., Tallahassee). Oct. 1967. Contracts F29600-67-C-0012; AT(40-1)-2903. 19p. (6571-ARL-TR-67-20). CFSTI.

Immediate detection of x rays (0.63r/sec) in four rhesus monkeys was demonstrated through the use of the conditioned suppression technique. Detection was evident in three monkeys after 20 trials in which x rays and unavoidable shock were paired, and after 5 trials of pairing x rays and shock for one monkey. Dose rate was decreased to 0.03r/sec and all subjects showed a high level of response suppression in the presence of x rays, but no suppression of response was evident during control trials. (auth) (USGRDR)

16379 (AD-668452) HISTOLOGIC REACTION OF ADULT RAT SKIN AFTER 13-MeV PROTON IRRADIATION AND ITS VIABILITY IN CELL CULTURE. Report for May 1964–June 1966. Caraway, Bobby L.; Prince, John E. (School of Aerospace Medicine, Brooks AFB, Tex.). Feb. 1968. 19p. (SAM-TR-68-16). CFSTI.

Thesis.

The carcinogenic effects of low energy (13 MeV) protons on adult rat skin were studied in two phases: Phase 1—A pathologic study in which the oncogenesis of proton irradiation was determined eight months postirradiation. Phase 2—Cell culture experiments based on the hypothesis that growth and viability of adult skin cells irradiated in vivo and later cultured in vitro would reveal carcinoma potential before actual tumor formation could be detected. In phase 1, one animal followed the anticipated pattern nine months postirradiation. It was biopsied for culture six times and in each instance gave a consistent growth in vitro. This animal later developed a basal cell carcinoma. In phase 2, no animals provided viable cells in culture at intervals of 5, 30, or 60 days postirradiation. The interval between 60 days and eight months postirradiation unfortunately could not be followed in this study. (auth) (USGRDR)

16380 (AEC-tr-7014) RADIOBIOLOGY. Translation of Radiobiologiya, 8: 483-656(1968). 238p. Dep. CFSTI.

Papers within the scope of NSA were abstracted from the original language and have appeared in previous issues. (C.O.)

16381 CAPILLARIA AND TRYPANOSOMA INFESTATIONS IN MICROTUS OCHROGASTER. Dunaway, P. B.; Cosgrove, G. E.; Story, J. D. (Oak Ridge National Lab., Tenn.). Wildlife Dis. Ass., Bull., 4: 18-20(Jan. 1968).

Ten prairie voles from Putnam County, Tennessee, were given 520 to 1270 rad of γ radiation. In comparison with other species of indigenous rodents, the voles were somewhat radioresistant. An animal that died after receiving 1084 rad was necropsied and the internal stomach wall was found to be greatly thickened. Numerous nematodes of the genus Capillaria were present in the gastric mucosa; it was thought that the thickening was caused by the parasites rather than by the radiation. Blood smears of the voles revealed the presence of Trypanosoma sp. (H.L.W.)

16382 CONTRIBUTION TO THE PROBLEM OF THE DIAGNOSIS OF CHRONIC POSTIRRADIATION DAMAGE. Beran, M. (Veterinary Research Inst., Prague); Pospisil, J.; Havlicek, F.; Dvorak, P. Cas. Lek. Cesk., 107: 1123-8(Sept. 6, 1968). (In Czech).

A group of rats was irradiated for 24 hr a day for a period of 400 days with a dose of 3654 mR; their weight increments and the peripheral hemogram were recorded. The only change observed was a permanent mild lymphopenia. The use of hematological criteria for the evaluation of damage caused by chronic small doses of ionizing radiation is discussed. (JPRS)

16383 PODKORKOVOSTVOLOVYYE FUNKTSII PRI DEYSTVII IONIZIRUYUSHCHEY RADIATSII NA ORGANIZM. (Subcortex Brainstem Functions Under the Effect of Irradiation). Abdullin, G. Z.; Patalova, V. N.; Petelina, V. S.; Shkhinek, E. K. Leningrad, Izdatel'stvo Meditsina, 1967. 161p.

The preferential localization of injuries produced by ionizing radiation in the higher parts of the central nervous system and the significance of functional disturbances of subcortical and brainstem formations in controlling some sympathetic and endocrine functions are considered in this book. Emphasis is placed on changes in the functional state and in the central control of the pituitary-adrenal-cortex system in radiation sickness. Pharmacological evidence of functional disturbances of subcortical and brainstem formations in irradiated animals is presented. Consideration is also given to the role played by controlling mechanisms of the subcortex and brainstem, and to healing processes accompanying radiation sickness. The book is intended for pathophysiologists, radiologists, radiobiologists, and endocrinologists. A bibliography is provided. (ATD) (TSS)

16384 STIMULATION OF PORCINE SPLENIC CULTURES BY A RADIATION-INDUCED LYMPHOID LEUKEMIA FILTRATE: A PRELIMINARY REPORT. Howard, E. B.; Jannke, C. C.; Clarke, W. J. (Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1830. Amer. J. Vet. Res., 30: 423-8(Mar. 1969).

Inoculation of a filtrate (pore diameter, 0.45 μ) of strontium-90-induced porcine lymphocytic leukemia tissues and plasma into newborn pig splenic cultures resulted in marked stimulation of growth rate, with increased blast transformation and mitosis of the lymphoid elements. Similar filtrates of myelogenous leukemia and of normal tissue origin did not elicit this response. (auth)

16385 EARLY REGENERATION OF ERYTHROID ELEMENTS IN IRRADIATED MICE BEARING THYMUS ALLOGRAFT IN A DIFFUSION CHAMBER. Awaya, Kazuhiko; Tomonaga, Susumu

(Yamaguchi Univ., Japan). Igaku To Seibutsugaku, 75: 165-71 (Nov. 1967). (In Japanese).

Male mice of Strong A strain about two months old were subjected to a 500 R dose of whole-body x radiation and given thymus transplants from five day old mice. Some of the transplants were given subcutaneously and others were enclosed in a diffusion chamber and given intraperitoneally. In the latter group nucleated cells appeared in the bone marrow and spleen on the tenth day following irradiation. Regeneration was not observed in the group transplanted subcutaneously or in those subjected to x radiation only. It was concluded that the humoral factor of the thymus plays an important role in the regeneration of erythroblasts in mice exposed to radiation. (NSA of Japan) (TSS)

16386 COMPARATIVE STUDIES ON ACUTE EFFECTS OF SINGLE WHOLE-BODY IRRADIATION WITH FAST NEUTRON, X-RAY, AND GAMMA RAY ON THE HEMATOPOIETIC ACTIVITY IN NORMAL MICE. Wake, Minoru; Takizawa, Shoichi (Hiroshima Univ.). Hiroshima Daigaku Igaku Zasshi, 15: 173-94(Feb. 1967).

Ten-week old female mice of ddN-JCL(CLEA) strain were given single whole-body doses of 14.1 MeV fast neutrons (320 rads), 180 kV x rays (375 rads), and ^{60}Co γ radiation (500 rads). All types of radiation resulted in a decreased number of medullary nucleated cells. The effects of fast neutrons on hematopoiesis were more pronounced than those of γ or x rays. Recovery was retarded at first, but increased during the second week after irradiation. Fast neutrons did not affect the histology of lymph nodes, spleen, or the thymus, but did affect that of the bone marrow. Changes in DNA content of hematopoietic organs were in agreement with histological findings. (NSA of Japan) (TSS)

16387 RADIATION-INDUCED CANCER OF THE ESOPHAGUS AS AN EXPERIMENTAL MODEL. Warren, Shields; Gates, Olive (New England Deaconess Hospital, Boston). Contract AT(30-1)-3777. Cancer Bull., 20: No. 5-6, 57-9(1968). (NYO-3777-15).

Cobalt-60 wires were implanted in the chests of mice in order to determine the probable dose at which carcinoma of the esophagus might appear. Doses of 100,000 R or more were required to produce the majority of esophageal cancers in the mice. The first carcinoma appeared 41 days after the initial exposure. A table is presented to show the occurrence of esophageal cancer in relation to dose and time after initial exposure. A graph is presented to show the per cent survival of all mice experimentally irradiated and the per cent of animals that developed cancer of the esophagus on an accumulative basis. The results indicate that the induction of cancer in man is unlikely, although the esophagus might be exposed to doses two or three times those now employed in radiotherapy. (H.L.W.)

16388 STUDY OF THE ADAPTIVE CAPACITY OF RATS TO PROLONGED ELECTRICAL IRRITATION APPLIED AT PERIODS LONG AFTER IRRADIATION. Fedotov, S. A. (Central Roentgen-Radiological Scientific Research Inst., Leningrad). Izv. Akad. Nauk Kaz. SSR, Ser. Biol. Nauk, No. 4, 75-8(1967). (In Russian).

One hundred twenty-seven three-month old rats were irradiated with 433 rads and subjected 1, 7, 12 and 16 months later to electrical irritation for a period of 25 days interrupted by two short rest intervals. The irritation was applied for 6 to 8 hours daily. Indicators for adaptability were the animals' weight and mortality curves. Reactions to the irritation did not depend on age. Weight curves of the majority of experimental animals were characterized by rapid decline in the first 5 to 6 days followed by a slower decline and some recovery during the first rest period, after which the decline continued. Animals which lost more than 30% weight usually died. Differences between the weights of experimental animals and controls were seen around the 15th day and sharpened thereafter. The same applied to mortality. It was concluded that rats which had recovered from acute radiation sickness reacted to late prolonged electrical irritation with greater and faster weight loss, less weight gain during rest periods, shorter survival and higher mortality rates. This points towards decreased adaptability of the organism to stress as a remote radiation effect. (ATD)

16389 INNERVATION OF REGENERATING SKIN UNDER CONDITIONS OF ACUTE RADIATION SICKNESS. Serdyukov, G. I. (Kiev Medical Inst.). Klin. Khir., No. 2, 82(1968). (In Russian).

Dogs received a wound 4 to 6 cm long either on the day they were exposed to whole-body x irradiation (300 R), at the height of radiation sickness, or during the period of clinical recovery. Degenerative changes in the skin tissue were found to proceed more rapidly and spread further in the experimental animals than in the control. Leukocyte infiltration and edema of the edges of the wound inflicted at the height of radiation sickness were less pronounced than in the control. Regeneration of connective tissue started later. The number of degenerating and disintegrating nerve fibers was far greater than in the control. The destructive processes were in the form of colliquation and coagulation necrosis. The radiation lesions markedly affected the regeneration of the terminal portions of the cutaneous nerves. Regeneration began later than in the control animals and it proceeded in atypical fashion (late differentiation of regenerating fibers, primitive endings, slow myelinization, etc.). (JPRS)

16390 THE INTRINSIC RATE OF NATURAL INCREASE OF IRRADIATED PEROMYSCUS IN THE LABORATORY. French, Norman R.; Kaaz, Howard W. (Univ. of California, Los Angeles). Ecology, 49: 1172-9(Autumn 1968).

The effect of continuous low-level exposure to γ radiation on a population of deer mice (Peromyscus maniculatus sonoriensis) in the laboratory was studied. The average dose rate was slightly greater than 1 R/day. One group was exposed as adults, with irradiation beginning when they were weaned (age 3 to 4 weeks); another group was the offspring of the irradiated adults, hence these animals were irradiated since conception. Descendants from three separate field populations were present in each group. The intrinsic rate of natural increase was increased in animals irradiated as adults as a result of an elevation of the instantaneous rate of birth and a reduction of the instantaneous death rate. Animals irradiated since conception showed a lower intrinsic rate of natural increase than the controls. Life span was shortened by irradiation and age specific natality was reduced by radiation, both by lowering the maximum number of young per female and by shortening the reproductive life spans of females. Reduction was greatest in the animals irradiated since conception. There was evidence of hyperovulation in the group irradiated as adults. There was variation among the three field populations represented, both in reproductive capacity of control animals and in sensitivity to radiation. Among controls, the population from the lowest field elevation had the greatest intrinsic rate of natural increase. This population showed the least sensitivity to radiation. The greatest sensitivity to radiation was in the population from intermediate elevations. It was concluded that field populations of Peromyscus living in favorable environments might withstand the degree of reduction induced by this level of radiation exposure. Field populations living under less favorable conditions possibly could not. (C.H.)

16391 SPECIFIC AREA OSSEOUS EFFECTS OF X RADIATION. Wuehrmann, A. H.; Greer, D. F.; Fleming, R. D.; Jarrah, H. (Univ. of Alabama, Birmingham). J. Dent. Res., 47: 1094-1103(Nov.-Dec. 1968).

A 0.5-cm diameter x-ray beam of a specified quality, directed at the mandibular molar region of adult male albino rats, was shown to destroy osteocytes in increasing amounts according to the radiation quantity used. The interval between exposure and the time rats were killed for examination appeared irrelevant. Osteocytic death seemed to be a function of exposure time. (auth)

16392 BEHAVIORAL DEFICITS AS A RESULT OF REPETITIVE EXPOSURE TO WHOLE-BODY X-IRRADIATION. McFarlain, Robert A.; Elder, S. Thomas; Boston, Barry (Louisiana State Univ., New Orleans). Proc. La. Acad. Sci., 31: 140-7 (Dec. 31, 1968).

After 45 naive, male rats were trained to bar-press for food on a VR-3 reinforcement schedule for 13 consecutive days, they were subjected to large single doses of x-radiation, regularly spaced repeated exposure to relatively small doses, or sham treatment. Number of responses per daily 20-min session and amount of food chow consumed per day were the dependent measures. Analysis of bar-pressing data taken over a post treatment interval of 39 days showed a significant loss within 4 hr of exposure to single regularly spaced doses. No evidence was found to support the idea that increased amounts of training would tend to reduce radiation produced response decrements. Analysis of food consumption rates is reported, but inference from these scores is not justified due to variations in food rates observed during the pre- and post-treatment intervals. (auth)

16393 STUDY OF THE SYNERGISTIC EFFECTS OF HEAT EXPOSURE AND IONIZING IRRADIATION IN THE HAMSTER. Chaffee, R. R. J.; Musacchia, X. J. (Univ. of California, Santa Barbara, Univ. of Missouri, Columbia). Proc. Soc. Exp. Biol. Med., 129: 718-20 (Dec. 1968).

Adult male hamsters were placed in a hot room, 34 to 35°, and heat acclimated for 2 months. Controls were maintained at 24°. Each animal was given a single whole-body exposure to ionizing radiation from a ^{60}Co source. Half of the heat-acclimated animals were then transferred to 24° and half returned to the hot

room. Half of the controls were placed in the hot room after irradiation. Comparisons of survival times were made; heat exposure either before or after irradiation, or both before and after irradiation lowered the survival time to less than 50% that of the controls, i.e., hamsters which were irradiated but not heat exposed. (auth)

16394 EFFECTS OF TIME INTERVAL AND DOSE OF IRRADIATION ON EXPERIMENTAL TUMOR. Sugita, Katsuhiko (Okayama Univ., Japan). Okayama Igakkai Zasshi, 80: 461-9 (Apr. 1968). (In Japanese).

The tumor used was solid type Ehrlich carcinomas experimentally induced in mice, and the total dose of each irradiation was 5,000 R. The effect of irradiation was determined by the survival time of the tumor bearing animals. The interval of 72 hours was taken as the standard interval. As a result it was found that the irradiation of 5,000 R at the interval of 72 hours with additional 100 R at every 24 hours lengthened the survival time of the tumor-bearing animals to 4.0 days in average. The survival time of the controls given no irradiation was 20.4 days in average. Further, in those groups given additional dose of 200 R or 300 R every 24 hours, the length of survival days was rather shortened. Besides these, some investigations were carried out to see what therapeutic effect such additional irradiation would have on the regional tumor and what systemic side effects. The effect on the regional tumor was determined by the activity of succinic dehydrogenase system in the tumor and systemic irradiation damages in the blood picture. The results revealed that in comparison to the group simply irradiated with 5,000 R at interval of 72 hours, the group given additional 100 R showed the recovery of the succinic dehydrogenase activity to be inhibited but the blood picture did not exhibit any appreciable change. In the groups given additional dose of 200 R or 300 R the succinic dehydrogenase activity was diminished and also the damage to blood picture was considerable. These findings indicate that when the irradiation is given at an interval of 72 hours and additional dose is given at the intermission period, such additional irradiation is effective at a certain appropriate dose. In this instance, the additional dose should be such as to inhibit the growth of tumor but not to cause much side-effect. In other words, divided doses of irradiation should be within the range which would serve the purpose of irradiation best. (auth)

16395 OCULAR HAZARDS OF TRANSSCLERAL LASER RADIATION. II. INTRAOCULAR INJURY PRODUCED BY RUBY AND NEODYMIUM LASERS. Smith, Richard S.; Stein, Marvin N. (Albany Medical Center). Amer. J. Ophthalmol., 67: 100-10 (Jan. 1969).

The ocular effects of transscleral radiation by non-Q-switched ruby and neodymium lasers were studied in living rabbits. In a number of rabbit eyes, posterior subcapsular cataracts of a characteristic configuration were produced. Dosage-related chorioretinal destructions are described. Various secondary changes involving the anterior segment that occurred after the initial injuries are discussed. The threshold of damage by the neodymium laser in the rabbit eye was 60 joules/cm^2, while minimal lesions were seen with the ruby laser at a level of 30 joules/cm^2. (C.O.)

16396 INTER-STRAIN GRAFTS OF TESTES IN CHICKENS. FERTILE "TESTOTESTES" OBTAINED BY GRAFTS OF TESTES OF WHITE WYANDOTTE CHICKENS IN X-RADIOSTERILIZED TESTES OF RHODE ISLAND RED CHICKENS. Benoit, J.; Brard, E. (College de France, Paris. CNRS, Paris). Compt. Rend. Soc. Biol., 162: 838-42(Nov. 23, 1968). (In French).

Testes of white Wyandotte chickens, grafted into testes of Rhode Island Red roosters previously x-radiosterilized, developed spermatozoa that were able to reach the male genito-excretory tract of the host and to fertilize the Rhode Island Red hen. Three successive generations, presenting the hybrid characteristics W x RIR, were thus obtained. (tr-auth)

16397 EARLY RAISED INCORPORATION OF ^{59}Fe INTO MOUSE BONE MARROW AFTER IRRADIATION. Vacek, A.; Ueno, Y.; Sugahara, T.; Davidova, Eva (Kyoto Univ.). Folia Biol. (Prague), 14: 471-5(1968).

The incorporation of ^{59}Fe into mouse bone marrow (femur) in the early postirradiation phase was studied. During the first 24 hours after irradiation, the incorporation of ^{59}Fe into the bone marrow of irradiated mice was found to be increased. The increase was greater when ^{59}Fe was injected 30 minutes before irradiation than when it was injected immediately after irradiation. The results support the view that temporary accumulation of intermediary red cell precursors occurs during the phase immediately following whole body irradiation and that the release of reticulocytes from the bone marrow is delayed. (auth)

16398 EFFECTS OF X-RAY IRRADIATION ON THYMECTOMIZED ADULT MOUSE. Kawabe, Kunihiko (Tokyo Univ.). J. Fac. Sci., Univ. Tokyo, Sect IV, 11: 189-91(Dec. 11, 1967).

The effect of sublethal x irradiation was examined in adult mice, with or without an intact thymus, special attention being directed to the wasting syndrome and mortality caused by irradiation. Mice of the ddY strain received a whole-body dose of 200 or 350 R 6 days after thymectomy. The increase in the body weight in the non-operated, nonirradiated group at 10th week was the greatest of all the groups, the value being 15.4% on an average. In the nonoperated, irradiated groups, the sham-thymectomized, irradiated, or non-irradiated groups, and the thymectomized, nonirradiated group the values for the average body-weight increase were practically the same, indicating that irradiation per se or thymectomy had little effect on the body-weight increase. The percentage survival was also little different in these groups. Therefore, thymectomy in the adult does not produce the wasting syndrome. However, in the thymectomized, irradiated group the effect of irradiation was manifest, the average body-weight increase becoming much less than those of other groups, and the percentage survival declining from 100 to 75. Twenty-five % of the mice in this group died of diarrhea. It was concluded that thymectomy in the adult mouse, as opposed to neonatal thymectomy, does not cause the wasting syndrome. Since, however, sublethal irradiation of thymectomized mice had definite effects on both mortality and the body-weight increase, in the adult animal, also, the presence of the thymus provides a safeguard against irradiation or other stressful conditions. (BBB)

16399 QUANTITATIVE HISTOLOGICAL STUDIES ON DELAYED EFFECTS OF PRENATAL X-IRRADIATION IN RAT CEREBRAL CORTEX. Brizzee, K. R. (Univ. of Utah, Salt Lake City). Contract AT(11-1)-1474. J. Neuropathol. Exp. Neurol., 26: 584-600(Oct. 1967). (COO-1474-5).

Fetal albino rats were exposed to 130 R whole body x irradiation on gestation day 13.5 at 60 R/minute. At 250 days postnatal age the brains were fixed by a 2-stage perfusion method. Brain weight and dimensions were significantly less in irradiated than control rats but the width/length and depth/length ratios were not significantly different. The brain weight/body weight ratio was higher in controls than in irradiated rats. Qualitative light microscope studies revealed no changes in Feulgen positive material in neurons or neuroglia, and no alterations in blood vessel structure, but an apparent decrease in Nissl material and in lipofuscin was observed in the larger neutrons in irradiated as compared with control specimens. Quantitative studies on cell populations and blood vessels were carried out at 20 equally spaced, successive depth levels between pia mater and deep portion of multiform layer. A bimodal curve for neuron packing density was observed with peak values between relative depth levels 6 and 8 (deeper portion of inner granular layer and outer part of inner pyramidal layer) and a second lower peak at levels 14 to 17 (middle region of multiform layer). A significant decrease in neuron density in irradiated as compared with control brains ($p < .01$) was observed at relative depth levels 3 and 4 (outer granular and outer pyramidal cell layers) and in levels 13-18 ($p < .05$) (major portion of multiform layer). A bimodal curve for neuroglial density was observed in control brains with peak values at levels 7 to 11, overlapping the region of greatest neuron density and at levels 17 to 20 (deep multiform layer) adjacent to subcortical white matter. In irradiated brains the curve for neuroglial density showed no clear cut peak in the depth levels corresponding to the inner granular and pyramidal layers, but exhibited a more or less continual increase in values from level 2 to the deepest level of the cortex. A decrease in neuroglial packing density in irradiated as compared with control brains was seen at levels 6 to 10 ($p < .05$), but no significant differences were observed at other levels. The curve for glia/neuron index was trimodal and virtually the reciprocal of that for neuron density. The proportion of the tissue occupied by blood vessels was greatest at levels 4 to 9 in controls and 6 to 9 in irradiated animals, thus corresponding closely to the initial peak of the curve for neuron density. The relative number of small capillaries (<5 μ) showed an initial peak at relative depth levels 5 to 9 corresponding to the highest values for proportion of tissue occupied by all blood vessels. An increase in the relative number of small capillaries in irradiated as compared with control brains was observed in 16 of the 20 depth levels examined but the differences were not significant ($p > .05$). The curve for relative number of larger vessels (>5 μ) showed no consistent pattern although a significant decrease in number of vessels in this size category was observed in irradiated, as compared with control rats at relative depth levels 5 to 8. (auth)

16400 INDUCTION OF GASTRIC ULCER IN RABBITS BY IRRADIATION UNDER LAPAROTOMY. Miura, Takashi; Hamada, Tatsumi (Osaka Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 28: 1245-51(Dec. 1968). (In Japanese).

Irradiation of the stomach of rabbits with x rays under laparotomy was carried out using ϕ 3 cm cones. Physical conditions of the irradiation were as follows: 50 kvp, filter 1 mm Al, FSD 9.6 cm, HVD 13.5 mm, 845 R per minute (field size ϕ 3 cm) or 810 R per minute (field size ϕ 2 cm). In the series of experiments in which field size was ϕ 3 cm, doses more than 1,400 to 1,500 R caused regularly ulcers and doses less than ca 1,100 R produced no remarkable degenerative changes of the mucosa except irregularity of glandular structure 4 weeks after irradiation. But in the series of ϕ 2 cm field, even a dose of 4000 R did not produce ulcer within 4 weeks, though a crater shaped change was formed macroscopically. No epithelial regeneration was found in the center of degenerated mucosa after doses more than 1,500 R, but at the boundary, regenerating epithelia and hyperplastic glands were found in all cases. (NSA of Japan)

16401 RESPONSE OF HUMAN SKIN TO ULTRAVIOLET LIGHT. **Johnson, Brian E. (Cornell Univ., New York); Daniels, Farrington Jr.; Magnus, Ian A. Photophysiology: Current Topics, 4: 139-202(1968).**

The following topics relating to effects of uv radiation on human skin are reviewed: historical aspects, human and animal skin as a special organ, the optics of the skin (anatomical considerations and measurements on skin), the reaction in human skin to sunlight, erythema studies with sunlight and artificial sources, uv-induced pigmentation and hyperplasia, reactions of animal skin to uv radiation, histological and histochemical studies, biochemical changes in uv irradiated skin, photoreactivation in uv-irradiated skin, clinical photopathology, chronic effects of uv radiation on human skin (aging and solar elastosis), and carcinogenesis. Chronically sun-damaged skin may develop hyperkeratotic lesions, namely actinic keratoses, which may progress to fully malignant squamous cell tumors. Basal cell carcinoma may also be found in susceptible skin. A recent survey has shown a significant relation between tumor location and the possibility of exposure to sunlight. Some problems involved in obtaining an action spectrum for uv carcinogenesis and interpretation of results obtained are discussed. (BBB)

16402 COMBINED EFFECT OF ACCELERATION AND IONIZING RADIATION ON CONDITIONED REFLEXES IN RATS. **Livshits, N. N.; Meizerov, E. S.; Zakirova, R. M. pp 169-83 of Nekotoryye Voprosy Kosmicheskoy Neyrofiziologii. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).**

The combined effect of acceleration and radiation on nerve centers is reported and compared to that of irradiation or acceleration only and that of vibration and radiation. The two latter effects had been reported in earlier papers. The study was conducted in rats using the motor reflex to food as an indicator and blood tests to determine leuko- and lymphopenia due to radiation. Groups of 6 to 8 rats were subjected 3 times to either the combined action of acceleration (in a centrifuge) of 10 G for 8 min, immediately followed by total x irradiation with a 50 R dose at 31 R/min or to the action of the centrifuge followed by irradiation. Controls were subjected only to the centrifuge. The first interval between tests was 2 weeks, the second 1 week. All animals appeared well and active and gained weight normally throughout the test. For the combined effect, it was found that acceleration somewhat reduced radiation leukopenia. A short-term lack of motor coordination was also seen. Evaluation of reflexes according to response to sound/light gave no uniform picture, although a disturbance of this ratio was found. The effect on conditioned reactions was similar to that seen after acceleration (increase of latency period and decrease of reactive force). The effect of the dynamic factor prevailed in all stages, both in respect to its importance and direction. A difference was seen only in that conditioned reflexes decreased in the first case according to the narcotic phase, and in the second according to the complete or incomplete comparative phase. Initial combined effects of vibration and irradiation are similar to those studied here, with prevalence of the dynamic factors. Later effects differ sharply, for in the first case, there was an addition of radiation and vibration effects while such addition was absent in the combined effect of radiation and acceleration. It is assumed that this difference in the later effects of these experiments is due to the higher radioprotective effect of acceleration compared to vibration. (ATD)

16403 ACUTE RADIATION SICKNESS IN SHEEP IN CONNECTION WITH TOTAL GAMMA RADIATION. **Kalugin, V. V. (All-Union Inst. of Experimental Veterinary Medicine, Moscow). Veterinariya, No. 2: 80-2(1968). (In Russian).**

Total γ radiation of adult sheep in a dose of 600 R and lambs in a dose of 400 R caused the severe form of acute radiation sickness in all animals, with death after 14 to 20 days (on the average for the two groups). Before and during the experiments the following indices were determined: weight, fatness, temperature, pulse, respiration, the condition of mucous membranes and fleece, the number of leukocytes and erythrocytes, hemoglobin content, hematocrit value and leukocyte formula. The indices were determined immediately after irradiation (first five minutes), and after 30 minutes, 1, 2, 4, 6, 8, 10, 12, and 24 hours, and subsequently one or two times per day up to the death of the animals. Profound changes in hematopoiesis and gas-energy metabolism occurred in the animals of both groups, even in the initial period of radiation sickness, and were most pronounced in sheep irradiated with a dose of 600 R. Later, as the pathological process developed, intermittent progressive leukopenia and a reduction in pulmonary ventilation and gas metabolism were noted. Saturation of arterial blood with oxygen did not change essentially. Saturation of venous blood, on the contrary, underwent substantial changes: it rose catastrophically to a certain level, and then (in the period of agony) it declined. The most evident pathologic-anatomical changes were observed in the sheep of the first group (600 R); it was typical of these animals that these changes were more pronounced the longer the duration of radiation sickness. (JPRS)

16404 EFFECTS OF NEUTRON IRRADIATION ON BLOOD AND CEREBROSPINAL FLUID PRESSURES IN THE BURRO (EQUUS ASINUS). **Wykoff, M. H.; Short, C. E. (Univ. of Tennessee, Oak Ridge). Amer. J. Vet. Res., 30: 73-6(Jan. 1969).**

Three groups of burros (Equus asinus) were irradiated with doses of 600, 300, or 100 rads of fast neutrons; the doses were given at the rate of 40 rads/minute delivered to a frontal plane through the nuchal crest of the burro. Heart rate, arterial and venous blood pressures, and cerebrospinal fluid (csf) pressure were measured before and after the burros were irradiated. These values were not significantly changed. Results of examination of csf indicated increased protein in all burros. These values were between 2.0 and 3.0 g/100 ml, as compared with the normal value of 0.07 g/100 ml. (auth)

16405 INFLUENCE OF ENVIRONMENTAL ACCLIMATION ON RESPONSE OF MONKEYS (MACACA SPP.) GIVEN X-IRRADIATION AND BONE MARROW TRANSPLANTS. **Allen, J. R.; Hall, A. S.; Carstens, L. A.; Chesney, C. F. (Univ. of Wisconsin, Madison). Amer. J. Vet. Res., 30: 113-25(Jan. 1969).**

Thirty-one monkeys were obtained directly from their natural environment. Ten of these monkeys were given 800 R of total-body x-irradiation (nonacclimated-nontransplanted group) and 21 were given 800 R of total body x-irradiation and then bone marrow transplants (nonacclimated-transplanted group). Twenty-one additional monkeys, in good physical condition, had been kept in captivity for at least 5 years. Seven of these monkeys were given 800 R of total-body x-irradiation (acclimated-nontransplanted group), and 14 were given 800 R of total body x-irradiation and then bone marrow transplants (acclimated-transplanted group). Differences in the gross appearance of the monkeys of different groups were not detectable. Rapid decrease in the erythroid elements of the blood in the nonacclimated monkeys resulted from extensive hemorrhage associated with internal parasitic lesions. There was a shift in the albumin: globulin ratio of the blood serum in monkeys of all groups; however, the shift was greater in the acclimated monkeys. Repopulation of the bone marrow was similar in monkeys of acclimated-transplanted and nonacclimated-transplanted groups. The acclimated-transplanted group of monkeys had a greater percentage of survivors than did the other groups of monkeys. (auth)

16406 EFFECTS OF ^{131}I THYROID DAMAGE ON LACTATION AND THYROID FUNCTION IN THE BOVINE. **Miller, J. K.; Swanson, E. W. (Univ. of Tennessee, Oak Ridge). J. Dairy Sci., 52: 95-100(Jan. 1969).**

Partial thyroid destruction was produced in one member of each of nine pairs of identical-twin dairy heifers with single oral doses of ^{131}I varying from 99 to 180 μCi per kilogram of body weight. Twin pairs were bred beginning two months after treatment. First-calving reproduction was normal in the thyroid-damaged heifers. During lactation the six heifers dosed with 144 to 180 μCi per kilogram averaged, as a percentage of their control mates, 7% thyroid iodine uptake, 28% thyroxine secretion rate, 31% plasma protein-bound iodine, 83% heart rate, and 99% body weight. Three heifers dosed with 99 to 111 μCi averaged for the same values, respectively, 86, 70, 72, 87, and 101% of their control twins. One pair of twins milked only two months; the others all completed 10-month lactations except two thyroid-damaged twins in which lactation ceased after six and seven months. Although thyroid-damaged twins initially appeared fatter than the controls, their milk fat tests averaged 82% of control tests during the first two months of lactation, after which there was no significant difference. Average measurements for control and thyroid-damaged heifers, respectively, were milk yield, 4,000 and 2,042 kg; milk fat, 4.29 and 3.96%; solids-not-fat, 8.77 and 8.66%; and 4% fat-corrected milk, 4,186 and 2,032 kg. (auth)

16407 THE INFLUENCE OF ACTINOMYCIN D ON SURVIVAL OF X-RADIATED RF MICE. Givelber, Harry; DiPaolo, Joseph A.; Schneiderman, Marvin (National Cancer Inst., Bethesda, Md.). Cancer Res., 28: 2484-8(Dec. 1968).

The effect of a single dose of actinomycin D, given at the time of irradiation, on x-radiation-induced leukemia and lymphoma in RF mice was investigated. The mice were treated with 300 R and actinomycin D in combination and separately. As measured by survival analysis, actinomycin D alone did not change either the incidence of lymphomas and/or leukemia, nor the overall survival rates. In combination with x-radiation, antinomycin D was far more toxic in male than in female mice, as manifested by mortality within 30 days after irradiation; it had no effect, however, on subsequent survival nor any consistent effect on the incidence of leukemia. The lack of consistent effects of actinomycin D on long-term survival or on the incidence of leukemia possibly may be related to the time of its administration in relation to x-radiation. (auth)

16408 OXYGEN TENSION: A DETERMINANT OF RADIOSENSITIVITY IN THE CHICK EMBRYO. Hopkins, B. J. (Univ. of Rochester, N. Y.). Aerosp. Med., 38: 613-16(June 1967). (UR-49-792).

A study of the relationship between oxygen tension and radiosensitivity in a complex biological system is reported. The developing chick embryo was irradiated at 22.5 hours (total incubation age) in the presence of either 0, 21, or 100% oxygen tension with 600 R to 1320 R, 600 R to 2450 R, or 1800 R to 3600 R, respectively of ^{60}Co γ radiation. Examination of the embryo at 44.5 hours showed that the least amount of damage as compared with controls, was produced by radiation exposure at 0% oxygen tension when measured in terms of the number of differentiated somite pairs (somitic number) and other pathological changes. On the other hand, radiation induced changes were maximal when radiation exposure occurred in pure oxygen. A plot of relative sensitivity versus oxygen tension at the time of irradiation showed that radiosensitivity increased very rapidly in going from 0 to 21% oxygen and then more gradually to a maximum at 100% oxygen tension (3 atm). It was concluded that the oxygen dependent radioresponse of the developing embryo is similar to that for other simple biological systems. A possible application of the principle to problems of space radiobiology is suggested. (auth)

16409 EFFECTS OF IONIZING RADIATION ON UTILIZATION OF SPATIAL CUES IN THE RAT. Seitz, Mary Sue Bordelon. Austin, Tex., Univ. of Texas, 1968. 111p.

Thesis.

Two groups of 21 each black-hooded male rats were trained on an open, elevated ladder maze under different training conditions. One group (Room) was always trained with the maze and the goal-box in the same position in the room, but with the internal conditions of the maze randomly varied. The other group (Maze) was trained with the internal conditions of the maze constant, but with the maze itself randomly rotated within the room. The distance from the start arm to the goal-box was constant for both groups. These two groups were each subdivided into a C group, and two E groups. The C groups were sham irradiated; two E groups (Room 700 R and Maze 700 R) were exposed to 700 R; the other two E groups (Room 900 R and Maze 900 R) were exposed to 900 R γ radiation. All groups were given four pre-irradiation training trails and 36 post-irradiation trials, with water as the reward. Tests for the utilization of spatial cues were performed on all groups. The prediction of a narrowing of attention was partially supported by the increment in performance of the 700 R Ss. An ERG on a 700 R rat (not used as a S) revealed no evidence of radiation insult to the eye. Pre- and post-radiation ERGs on rats exposed to 900 R pointed to the possibility that some instances of focused attention may be the consequences of a restricted visual field. The failure of irradiated Room Ss to show a statistically significant decrement in behavior as measured by either error or running speed ruled out a functionally significant vision loss, as did the non-random distribution of errors by conditions by the Maze 900 R Ss. The factors involved in the Maze 900 R Ss' performance decrement as compared to their controls suggested that some radiation dose levels exacerbate the difficulty rats have in reorganizing maze-room relationships. With regard to running speed comparisons between irradiated groups and their controls, the only significant difference was seen in an increment in total running time of the Maze 700 R Ss. This could not have been a function of the radiaton dose alone since their Room counterparts' running speed was faster and in line with that of the Room Control Ss. This research suggests the need for additional studies designed to define the relationships between radiation insult and behavioral change. (Disser. Abstr.) (TSS)

16410 DYNAMICS OF CHANGES IN THE OSMOTIC RESISTANCE OF LEUKOCYTES TO PHYSICAL EXERCISE UNDER NORMAL CONDITIONS AND AFTER IRRADIATION. Loginova, T. G. Lab. Delo, No. 3, 135-40(1968). (In Russian).

Brief physical exercise (swimming) helped to increase the osmotic resistance of leukocytes in healthy rats, but 24 hours after irradiation it caused only a transient increase, after which it diminished until the end of the experiment. Prolonged exercise had no effect on the osmotic resistance of leukocytes in healthy animals, but 25 hours after irradiation it tended to increase. It began to diminish two months after irradiation and continued to do so throughout the experiment. At the end it returned to the normal level. (JPRS)

16411 HEME AND GLOBIN SYNTHESIS AND RELATED PARAMETERS IN BLOOD FROM THE X-IRRADIATED DUCK. Klein, J. Raymond (Brookhaven National Lab., Upton, N. Y.). Radiat. Res., 37: 50-6(Jan. 1969).

Decreases in the rates of heme and globin synthesis, turnover of free protoporphyrin, transfer of plasma iron to erythrocytes, and incorporation of plasma iron into heme in duck blood in vitro and in the concentration of protoporphyrin and proportion of reticulocytes in blood were observed at one to eight days after x irradiation of the animal. The decreases in rates and porphyrin concentration apparently were a consequence of the decrease in reticulocytes—that is, of erythropoietic arrest. The various parameters were found unchanged at five and thirty minutes after irradiation of the animal and after direct irradiation of blood. The estimations of synthesis and porphyrin turnover were based on incorporation of glycine 2-^{14}C, the other rates on incorporation of labeled iron. (auth)

16412 UPPER RESPIRATORY TRACT CLEARANCE IN RATS AFTER THORACIC IRRADIATION. Watson, Joseph A.; Auld, Judith A.; Spritzer, Albert A. (Univ. of Pittsburgh). Radiat. Res., 37: 57-70(Jan. 1969).

The thoracic region of rats was irradiated to initiate a sequence of histopathological changes in the lungs. The clearance of particles that were injected intratracheally into the lungs was measured at one hour and at seven, 15, and 30 days following irradiation. Clearance rates were measured directly by an esophageal collection technique over a 9.5-hour period. No significant difference in the cumulative clearance of the particles over 9.5 hours or in the clearance rates was detected between irradiated and sham-irradiated animals, although severe histopathological damage was present in the lungs of the irradiated animals. A composite clearance curve for all animals over a 9.5-hour period was described by two exponential functions with half-life values of 0.46 hour and 3.83 hours, respectively. (auth)

16413 EARLY CHANGES IN THE FINE STRUCTURE OF THE THYROID OF MIDLETHALLY IRRADIATED DOGS. Shively, James N.; Epling, Glenwood P. (Colorado State Univ., Fort Collins). Radiat. Res., 37: 71-82(Jan. 1969).

Changes in the fine structure of the thyroid follicular epithelium at selected times during the first week after midlethal irradiation of young dogs were similar to those seen after the administration of thyroid stimulating hormone. This similarity supported the observations of others that the early thyroid response was mediated by increased pituitary activity. The hypertrophy and edema of the endothelial cells of small blood vessels soon after irradiation and the subsequent endothelial atrophy seen later were consistent with the hemorrhagic diathesis which developed in these dogs. (auth)

16414 CHANGES IN SURVIVAL AFTER X-IRRADIATION OF XENOPUS EMBRYOS AT DIFFERENT PHASES OF THE CELL CYCLE. Hamilton, Louie (Middlesex Hospital Medical School, London). Radiat. Res., 37: 173-80(Jan. 1969).

Xenopus embryos were exposed to 956 rads of x rays at different times after fertilization. Cell divisions were synchronous at least in the first three cycles studied. The percentage of embryos surviving for three days was the criterion of sensitivity. It was found that, during the first three cleavage cycles, greatest sensitivity to x rays was at telophase early interphase, and least sensitivity was at late interphase. Sensitivity increased from prophase through metaphase, anaphase to telophase, and decreased throughout S. Changes in survival after x rays approximately corresponded to changes in nuclear DNA content. (auth)

16415 SIZE DISTRIBUTION CHANGES IN PERIPHERAL LYMPHOCYTES OF THE RAT AFTER X-IRRADIATION. Berke, H. L.; Wilson, G. H.; Berke, E. S. (Wayne State Univ., Detroit). Contract AT(11-1)-1630. Radiat. Res., 37: 181-91(Jan. 1969).

A group of albino rats, Sprague-Dawley strain, were exposed to x rays at levels of 1, 3, 10, 30, and 100 R in single or weekly doses to determine the sensitivity of the response of blood lymphocytes to ionizing radiation in terms of their size distribution. The cells were categorized as large (>12 microns) or small (<12 microns)

on the finding that the median diameter of the lymphocyte in the normal animal was 12 microns (range 8.5 to 17 microns) as measured with a calibrated ocular micrometer at 1600× on Wright-Giemsa-stained blood smears. The ratio of the sum of large lymphocytes and monocytes to small lymphocytes sized in random fields was used as an index of response. The lymphocyte ratios of the animals exposed only once to 30 R or less were not significantly different by Student's t-test from control values. The dose-ratio relationship was exponential for repetitive exposures, while that for single irradiations was not at all clear. The possible use of this indicator of response as a biological dosimeter and thus for determination of the biological equivalence (relative biological effect) of other types of ionizing radiation appears feasible under the experimental conditions used in this study. (auth)

16416 KINETICS OF RECOVERY FROM INJURY AFTER WHOLE-BODY X-IRRADIATION OF THE FISH ORYZIAS LATIPES AT DIFFERENT TEMPERATURES. Egami, Nobuo (National Inst. of Radiological Sciences, Chiba, Japan). Radiat. Res., 37: 192-201(Jan. 1969).

To resolve the details of recovery processes from radiation injury after whole-body irradiation in the fish Oryzias latipes, 3 or 4 kR of x rays was given in two divided doses. The interval between the two fractions varied from five minutes to 30 days, and the water temperature during the intervals was adjusted to 15 or 24°C. After the second irradiation, the 30-day mortalities in different groups of fish were compared. On the basis of the findings from these experiments and histological studies on the intestine and hematopoietic organs of irradiated fish, three phases in the recovery processes were formulated. During the first three hours after irradiation, a rapid recovery from the injury took place, reflecting intracellular repair in tissue involved. This was followed by the second phase, showing characteristic fluctuations in magnitude of injury. The time required for the peak of recovery and the following depression to occur was longer at 15°C than at 24°C. It seems probable that during this phase cells appeared to be synchronized with respect to cell division and the cells might exhibit difference in radiosensitivity according to the stage of cell cycle. The third phase began more than three days after irradiation. Thus, the recovery from radiation injury appears to be related to repopulation of cells in critical organs, and at least three different phases are involved in the events. (auth)

16417 BIOCHEMICAL EFFECTS OF IRRADIATED SUCROSE SOLUTIONS IN THE RAT. De, A. K.; Aiyar, A. S.; Sreenivasan, A. (Bhabha Atomic Research Centre, Bombay). Radiat. Res., 37: 202-15(Jan. 1969).

The in vitro and in vivo effects of irradiated sucrose solutions on some enzyme systems in rats were investigated. A fraction derived from irradiated sucrose solution and reportedly cytotoxic to cell cultures was observed to inhibit succinate oxidation and coupled phosphorylation by rat liver mitochondria in vitro. Lipid, protein, and DNA synthesis, as evidenced by incorporation of isotopically labeled precursors, were also inhibited in vitro, presumably as a result of primary impairment of oxidative phosphorylation and hence of the formation of ATP. The toxicity exhibited by irradiated sucrose solution was considerably reduced when irradiation was carried out under nitrogen or in the frozen state or in a buffered condition at neutral pH. Autoclaved sucrose solutions exhibited similar in vitro toxicity toward oxidative metabolism, but there appeared to be qualitative differences between the degradation products due to radiolysis and heat-treatment. Assessed by various parameters, no deleterious effects could be observed in rats fed the irradiated sucrose solution for a period of eight weeks. Studies with sucrose-U-^{14}C indicated that the products of radiolysis when orally administered to rats were rapidly metabolized and excreted with no detectable retention in the tissues of the animal beyond 30 hours. (auth)

16418 EFFECT OF TUMOR INFUSION ON IRRADIATED LYMPH NODES. Ujiki, Gerald T.; O'Brien, Paul H.; Putong, Paul B.; Towne, William S. (Northwestern Univ., Chicago). Surg. Forum, 19: 77-8(Oct. 1968).

From Conference on Fundamental Surgical Problems, Chicago, Ill. See CONF-681036.

Rabbits were irradiated at 1,000 to 3,000 rads over a rear limp. Ten days later, V-2 carcinoma cells were injected into the popliteal lymph vessel. Three to six weeks later the animals were killed and examined for tumors. At three weeks, distant tumor growth was significantly increased in irradiated rabbits. At six weeks, no significant difference in tumor incidence in pelvic nodes was noted between control and irradiated animals. (C.O.)

16419 IMPLANTABLE NUCLEAR FUEL CAPSULES FOR ARTIFICIAL HEARTS: IN VIVO DOSIMETRY. Norman, John C. (Harvard Medical School, Boston); Covelli, Victor H.; Bernhard, William F.; Spira, J. Surg. Forum, 19: 140-3(Oct. 1968).

From Conference on Fundamental Surgical Problems, Chicago, Ill. See CONF-681036.

The development of a 16.01 and a 25 thermal-watt ^{238}Pu capsule and the results of implantation in dogs are described. Results indicate that the excess heat and irradiation from nuclear fuel sources for artificial heart capability can be tolerated for some time. The longest survival of a 16 watt implant was living at nine months and the longest survival for the 25 watt implant was two months. A table gives the γ plus neutron radiation doses to various organs and their distance from the capsule. (C.O.)

16420 COLLAGEN AND MUCOPOLYSACCHARIDE SYNTHESIS IN HEALING IRRADIATED WOUNDS. Bryant, W. Michael; Slesh, Marvin Z.; Weeks, Paul M. (Univ. of Kentucky, Lexington). Surg. Forum, 19: 503-5(Oct. 1968).

From Conference on Fundamental Surgical Problems, Chicago, Ill. See CONF-681036.

Radiation effects on wound incorporation of ^{14}C-labeled proline, tritium-labeled glucosamine, and subsequent hydroxylation of ^{14}C-labeled proline were studied in rats. Standardized wounds were irradiated with a dose of 750 or 1,500 rads. At intervals of one to 21 days, the labeled materials were given and the animals were sacrificed 24 hr later. A dose of 750 rad resulted in increased ^{14}C proline in abdominal skin and wound tissues. The 1500 rad dose did not significantly affect the ^{14}C proline uptake. Only the higher dose effected a decrease in ^{3}H glucosamine uptake. It is concluded that the radiation effects on wounds are the result of a systemic factor since parallel effects are found on nonirradiated abdominal skin. (C.O.)

16421 THE RESPONSE OF THE SKIN OF SWINE TO INCREASING MULTIPLE EXPOSURES OF X-RAY (250 kVp). Archambeau, J. O.; Mathieu, G. R.; Brenneis, H. J.; Thompson, K. R. (Brookhaven National Lab., Upton, N. Y.). Radiat. Res., 37: 141-60(Jan. 1969).

The evolution, the time course, and the dose dependence of the moist reaction occurring in the skin of swine following increasing exposures given in two equal increments at intervals of six hours and 24 hours, and in five increments at daily intervals were quantified. The time of the first appearance of the moist reaction was variable, occurring between 15 and 22 days following irradiation. The irradiated field was maximally involved with a moist reaction between 22 and 23 days, and the moist reaction was maximally healed between 29 and 33 days. The greatest variation in the parameters of the moist reaction was noted when the total exposure was given in two equal increments at a 24-hour interval. The exposure at which 50% of the fields were not healed by 49 days following irradiation was 2437 R following single exposures; 2794 R following two exposures given at an interval of six hours; 3360 R following two exposures given at an interval of 24 hours; and 4761 R following five exposures given at an interval of 24 hours. (auth)

Man

Refer also to abstracts 16258, 16299, 16331, and 16340.

16422 MORPHOLOGICAL CHANGES IN THE TRACHEA AND BRONCHI FOLLOWING BETATRON IRRADIATION OF BRONCHIAL CARCINOMA. Ruckes, Josef; Hollstein, Harald (Pathologische Institut, Berlin). Strahlentherapie, 136: 515-20(Nov. 1968). (In German).

The bronchial tree in patients treated for bronchial cancer with the betatron was studied for radiation-induced modifications. Basically three types of modifications are found either alone, or combined: atrophic tracheo-bronchitis, which can involve all parts of the bronchial tree, the pseudo-membranous-necrotizing tracheobronchitis, mainly limited to the trachea and the main broncni, with perforation and formation of fistulae between the pulmonary artery, the aorta, the esophagus and the neighboring bronchi, and the obstructive and destructive bronchitis, localized in a segmental and subsegmental bronchus, whose normal evolution leads to the well known radiation fibrosis, with extensive retraction and complete functional loss. (auth)

16423 UNUSUAL CAUSES OF BRONCHIAL OBSTRUCTION. Ott, Alois (Sonderabteilung fuer Strahlentherapie im Krankenhaus der Stadt, Vienna). Strahlentherapie, 136: 521-8(Nov. 1968). (In German).

Bronchial cancer is the main cause of bronchial obstruction. Other possibilities, however, do exist. Three rare cases of bronchial stenosis are described: chronic bronchitis obliterans, inhalation of a foreign body, and radiation reaction during telecobalt-therapy of a bronchial carcinoma. (auth)

16424 CLINICAL EVALUATION OF THE DETERMINATION OF THYROXINE IODINE. Cassidy, Carl E. (Medical Center

Hospitals, Boston); Benotti, Joseph; Peno, Samuel. J. Clin. Endocrinol. Metab., 28: 420-1(Mar. 1968).

To assess the value of a method for determining thyroxine iodine, 189 patients were examined for evidence of thyroid disease. The modified method is described and results are presented in tabular form. Of the patients examined, 22 had untreated hyperthyroidism or myxedema that was spontaneous or had resulted from treatment with radioiodine or antithyroid drugs. The value for thyroxine iodine was calculated to be 65.3% of the serum thyroxine. Data confirmed the finding that the determination of thyroxine iodine is a reliable index of thyroid function. (C.O.)

16425 CUTANEOUS REACTION DEVELOPED DURING THERAPEUTIC IRRADIATION WITH BUNDLES OF ACCELERATED ELECTRONS. De Marzi, Stefano; Taddei, Lorenzo (Univ., Florence). Nunt. Radiol., 33: 903-16(Aug. 1967). (In Italian).

It was observed that: the site of the irradiated skin may condition the appearance of the reaction at lower or higher dosages and with different characters of intensity; the interposition of an absorbent layer (Mix D) provokes an earlier and more intense reaction; the desquamation was not aggravated by the prosecution, without interruption, of the treatment. On the contrary, in case of humid epidermiolysis, the treatment was to be stopped for some days, since otherwise the lesion tends to aggravate; no relationship was observed between cutaneous reaction and value of energy; the wideness of the fields seems to affect more the first phase of the reaction than its successive evolution; the regression of the cutaneous reaction occurred within a short interval of time. (auth)

16426 MYELOPATHY FROM IONIZING RADIATION. Smaltino, F.; Bernini, F. P.; Elefante, R. (Univ., Naples). Nunt. Radiol., 33: 917-35(Aug. 1967). (In Italian).

A case of myelopathy induced by ionizing radiation is described. The clinical and histological features of the syndrome are outlined and compared with 80 previous cases reported in the literature. Probable pathogenic bases of the myelopathy and the problem of tolerance of the human spinal cord to radiation are discussed. (auth)

16427 HEMOGRAMS OF URANIUM MINES EMPLOYEES IN THE PRIBRAM AREA. Kriklava, J.; Vich, Z. (Industrial Inst. of Public Health of the Uranium Mining Industry, Pribram, Czech.). Cas. Lek. Cesk., 107: 1367-72(Nov. 1, 1968). (In Czech).

Hemograms of 4021 employees of the uranium mines, 3642 of them miners, were evaluated. Although there were wide differences among the investigated subjects, the average values were similar to those of the general population. No evident damage of hematopoiesis was found; some changes in the hemograms were due to the work in the mines. Data are tabulated. (JPRS)

16428 RETAINED FERTILITY FOLLOWING RADIOTHERAPY FOR RECTAL CARCINOMA. CASE REPORT. Krauss, A.; Buerger, G. (Univ., Leipzig). Munchen. Med. Wochenschr., 109: 1015-7(May 5, 1967). (In German).

The case of a female who delivered a full-term healthy male child 10 years after colostomy and intensive radiation treatment of a cancer of the rectum is reported. The longitudinal and circular muscles of the sigmoid colon contracted simultaneously with the uterus. It is discussed, whether in certain cases — young females with a strong desire for children — cancer of the cervix could be treated with radium and subsequent lymph node dissection. (auth)

16429 CASE OF ACUTE RADIATION LESIONS OF THE HANDS DURING WORK WITH AN ELECTRON ACCELERATOR. Orlov, V. M. (Inst. of Industrial Hygiene and Occupational Diseases, Moscow). Klin. Med. (Moscow), No. 10, 37-9(1967). (In Russian).

Both hands of a 31-year-old man were accidentally exposed for 40 sec to 24,000 R from an electron accelerator with a beam energy of 1 MeV. The victim did not seek help until 12 days later. Blisters appeared on day 21 on all the fingers accompanied by symptoms of neuritis. Examination 9 months later revealed marked atrophy of the skin, depigmentation, deformity of the nail plates, erosion, fibrosis, and contractures. From the first day of admission to the hospital, the patient received comprehensive therapy including infiltration anesthesia, vitamins, injections of tissue preparations (particularly aloe extract), pachycarpine, electrophoresis with calcium and possible iodide as well as topical applications of various ointments. Eighteen months after the accident the patient was still unable to work, with a very poor prognosis for complete functional recovery of the hands. Contributing factors were the delay in seeking help, failure to observe the recommended regimen, and steam burns of the hands several years before. (JPRS)

16430 STUDIES ON LYMPHOCYTES. X. INFLUENCE OF EXTRACORPOREAL IRRADIATION OF THE BLOOD ON LYMPHOCYTES IN CHRONIC LYMPHOCYTIC LEUKEMIA: APPARENT CORRELATION WITH RNA TURNOVER. Stryckmans, P. A.; Chanana, A. D.; Cronkite, E. P.; Greenberg, M. L.; Schiffer, L. M. (Brookhaven National Lab., Upton, N. Y.). Radiat. Res., 37: 118-30(Jan. 1969).

In four patients with chronic lymphocytic leukemia the lymphocytes from 500 ml of their blood were labeled in vitro with tritiated cytidine and autotransfused. Samples of blood, lymph node biopsies, and bone marrow aspirate were autoradiographed, and the in vivo turnover of RNA was estimated by the change in mean grain count of the labeled lymphocytes. The patients were subsequently treated by extracorporeal irradiation of the blood (ECIB). The clinical course of the disease, and the lymphocytopenic effect of the extracorporeal irradiation, varied inversely with the rate of RNA turnover. The hypothesis was made that the increased radioresistance of chronic lymphocytic leukemia lymphocytes is related to increased RNA turnover of the lymphocytes. (auth)

Radiation Effects on Plants

Refer also to abstracts 16260, 16261, 16270–16272, 16279, and 16356.

16431 (ORNL-TM-2235) NEUROSPORA EXPERIMENT P-1037. Quarterly Progress Report to the National Aeronautics and Space Administration, July 1–September 30, 1967. de Serres, Frederick J. (Oak Ridge National Lab., Tenn.). Nov. 1968. Contract W-7405-eng-26. 27p. Dep. CFSTI.

Reports are presented on four different aspects of the Neurospora experiment associated with the flight of Biosatellite B. Dosimetry tests were conducted at Cape Kennedy in which three types of dosimeters (E.G. and G. LiF, E.G. and G. CaF_2:Mn, and Con-Rad LiF teflon-disc) were inserted into the Neurospora hardware prior to exposure to γ rays from a ^{85}Sr source. The separate estimates of the roentgen exposures from the three types of dosimeters were in good agreement. It was further determined that 6.3% of the total exposure of the Neurospora samples was from scattered radiation with energy of less than 100 keV. In the 201 Gantry Exercise, the biological payloads were prepared and delivered for loading on schedule to coordinate these procedures with other groups working on the assembly. X irradiation of three of the modules from the 201 test resulted in foreward-mutation frequencies that were in agreement with frequencies expected by extrapolation of dose-response curves. The 301 Gantry Exercise in which the sample modules were loaded and delivered to Cape Kennedy was equally successful and provided a final check of the actual flight hardware. Final preparations for the actual flight of Biosatellite B were made, telemetry data on the temperature profile of the Neurospora hardware during flight was collected, and the post-flight assay of the materials is underway. (E.R.B.)

16432 STUDIES ON VARIETAL DIFFERENCES IN RADIOSENSITIVITY IN RICE. II. THE RADIOSENSITIVITIES WITH RESPECT TO THE REDUCTION IN SEEDLING HEIGHT, COLEOPTILE LENGTH, POLLEN FERTILITY, AND SEED FERTILITY, AND TO THE FREQUENCY OF CHLOROPHYLL MUTATION. Ukai, Yasuo (Tokyo Univ.). Ikushugaku Zasshi, 18: 127-38 (1968). (In Japanese).

Clear varietal differences were observed in the reduction in seedling height and coleoptile length and not in induced pollen and seed sterility and mutation frequencies following exposure of seeds to x or γ rays. Correlation was significant between the sensitivities measured by root length reduction and that measured by inhibition of seedling growth and coleoptile elongation. (auth)

16433 STUDIES ON VARIETAL DIFFERENCES IN RADIOSENSITIVITY IN RICE. IV. MODIFICATION OF VARIETAL DIFFERENCES WITH SOAKING OF SEEDS BEFORE IRRADIATION. Ukai, Yasuo (Tokyo Univ.). Ikushugaku Zasshi, 18: 261-6(1968). (In Japanese).

Dose-response curves for root growth could be approximated by the same general function as for dry seeds. Correlation of the x radiosensitivity between soaked and dry seeds was significant with soaking up to 24 hours. The change in the sensitivity with increase in soaking time from 1 to 6 hours and with drying-back of seeds showed high negative correlation to the sensitivity in dry seeds. (auth)

16434 COMPARATIVE STUDY OF THE GAMMA EXPOSURE EFFECT OF SEEDS IN RELATION TO CHANGES OF NUCLEIC

ACID AND PROTEIN CONTENT IN WHEAT AND BARLEY IN ONTOGENESIS. Chopyak, A. M.; Boudnitskaya, E. V.; Stoletov, V. N. (Inst. of Biochemistry, Moscow. Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Biol., No. 5, 663-73(Sept. 1968). (In Russian).

Changes in content of nucleic acids and proteins during development of the Kraznozernaya variety of wheat and the Viner variety of barley were studied in seeds, seedlings, and shoots following exposure to 5, 10, and 40 kr doses of γ radiation. A dose effect on DNA, RNA, and protein content of barley and wheat seeds was observed. Effects of 5 kr doses on DNA and RNA content of vernalized and nonvernalized wheat seeds were observed. A disturbance in the correlation of RNA and protein synthesis during development of wheat was noted following exposure to 10 kr doses. (H.L.W.)

16435 EFFECTS OF GAMMA IRRADIATION ON THE DEHYDROGENASE ACTIVITIES AND ON THE PROTEINS OF IRISH GROWN WHEATS. O'Hara, C. E. (Agricultural Inst., Oak Park, Ireland). Radiat. Bot., 9: 33-8(Feb. 1969).

Grain samples of spring varieties Atle, Quern and Progress were treated with 1×10^6 Rads and 5×10^6 Rads of ^{60}Co γ-rays. The lower dose reduced production of formazan from 2,3,5-triphenyltetrazolium chloride (TTC) to 33 and 36% of the controls in the varieties Atle and Progress respectively, and to 48% in the case of Quern. At the higher dose no formazan was produced. Irradiation increased apparent biuret protein contents. This was investigated by measuring the quantities of biuret protein and nitrogen extracted by 0.01 M pyrophosphate buffer, 0.05 N acetic acid and 0.1 N potassium hydroxide. In Progress and Quern varieties the irradiation increased the amount of pyrophosphate and acetic acid soluble biuret protein and nitrogen at the expense of the potassium hydroxide soluble biuret protein and nitrogen. In Atle the pyrophosphate and potassium hydroxide soluble biuret protein and nitrogen increased, with a decrease in acetic acid soluble biuret protein and nitrogen. These results show that the solubility properties of the proteins of Quern are like those of Progress, rather than Atle, after irradiation. (auth) (UK)

16436 STUDY OF THE INDIRECT EFFECTS OF X-IRRADIATION ON THE ROOTS OF VICIA FABA. Mueller, H. P. (Univ. of Bonn). Radiat. Bot., 9: 49-59(Feb. 1969). (In German).

Irradiation of one half of the root-system of Vicia faba with x-rays (500, 1000 and 1500 R) produced in roots that were shielded from irradiation, changes of indices of mitosis, displacements of the relation between mitotic phases, reduced root growth and changes in respiratory activity. These findings suggest indirect effects of irradiation. This was shown by the fact that apparently toxic metabolites, so-called "radiotoxins," get into the nonirradiated roots from the irradiated roots and produce the injuries mentioned. These "radiotoxins" are assumed to result in structural changes of the cytoplasm. (auth) (UK)

16437 EFFECT OF ACUTE GAMMA IRRADIATION ON THE INCIDENCE OF TUMOR-LIKE STRUCTURES AND ADVENTITIOUS ROOTS IN LETTUCE PLANTS. Bankes, David A.; Sparrow, Arnold H. (Brookhaven National Lab., Upton, N. Y.). Radiat. Bot., 9: 21-6(Feb. 1969).

Acute γ-irradiation caused tumor-like structures and an increase in the incidence of adventitious roots on lettuce (Lactuca sativa H V great lakes). While untreated plants of this variety only occasionally develop adventitious roots on stems, the number of plants with adventitious roots increased after exposures of 4 and 6 kR and reached 100% after 7 kR. Similarly, the number of adventitious roots per plant increased with exposure dose. Some roots formed directly on the stems, but they occurred more frequently on small (1 to 5 mm dia) bulbous, nonchlorophyllous tumors which developed on leaves as well as on stems. Larger (up to 30 mm dia) chlorophyllous tumors formed after exposures of 6 and 7 kR. They were associated with basal leaves, being most common at the bases of the blades. In some cases they occurred along the leaf margins. Of the plants exposed to 6 kR, 80% became tumorous whereas only 50% of those exposed to 7 kR formed tumors. (auth) (UK)

16438 RELATIONSHIP BETWEEN RADIATION DOSE RATE AND LETHALITY OF DIPLOID CLONES OF SOLANUM. McCrory, Gerard J.; Grun, Paul (Pennsylvania State Univ., University Park). Radiat. Bot., 9: 27-32(Feb. 1969).

A preliminary study was carried out to establish the relationship between dose rate and the lethal effect of ^{60}Co radiation. Clonal rooted cuttings of Solanum were exposed to 9 kR, a predicted lethal dose, during twelve different periods of time corresponding to dose rates of 2250 R/min through a geometric progression to 1.09 R/min. The 9 kR dose was lethal when the dose rate was 70.3 R/min or greater. The dose was progressively less effective when delivered at lower rates, presumably as a result of operation of repair mechanisms, and at the lowest rates used the irradiations had a negligible effect. (auth) (UK)

16439 EARLY LESION FROM LOW DOSES OF X-IRRADIATION IN PLANT CELLS. Tanada, T. (Dept. of Agriculture, Beltsville, Md.). Radiat. Res., 37: 103-7(Jan. 1969).

A photoreversible attachment of barley root tips to wet glass surfaces was found to be sensitive to low doses of x irradiation. Photoreversibility was lost progressively with increasing dosages. The response to x irradiation was detected a few minutes following exposure. Since the photoreversible process is mediated by phytochrome, it is suggested that phytochrome or the membrane with which it could be associated might be an initial target of ionizing radiations in plant cells. The implication of this observation on the mechanism of radiation inhibition to cell division is discussed. (auth)

16440 RUSSET-FREE SECTORS ON FRUITS OF 'GOLDEN DELICIOUS' APPLE TREES AFTER GAMMA IRRADIATION. Decourtye, L. (INRA, Angers, France). Proc. Amer. Soc. Hort. Sci., 91: 73-7(Dec. 1967).

Twelve of 27 Golden Delicous apple buds receiving gamma irradiation each produced at least one fruit with a sector free of russet. No russet-free sectored fruits were observed in controls of the same clone. The sectors involved approximately $^2/_5$ of the fruits; neither all fruits from a given tree nor a whole fruit was found free of russet. Among suggested explanations of the phenomenon, the best one seems to be the uncovering of a periclinal chimera by tissue damage as a result of irradiation. (auth)

16441 RADIOSENSITIVITY OF GEMMAE OF LUNULARIA CRUCIATA TO ACUTE GAMMA IRRADIATION. Miller, Morton W. (Univ. of Rochester, N. Y.). Bryologist, 71: No. 2, 73-81 (Summer 1968). (UR-49-878).

Gemmae of Lunularia cruciata were irradiated with ^{60}Co γ rays at exposures up to 12 kR and scored for survival after one and three weeks of growth. The reproductive integrity of the apical cells of the gemmae was inhibited by exposures lower than those required for complete lethality of the gemmae. The apical cells have a nuclear volume ($110.5 \pm 14.2\ \mu^3$) larger than that of other vegetative cells ($66.4 \pm 10.4\ \mu^3$) and are the most radiosensitive when exposure is measured in kR. At the lethal exposure, however, the energy absorbed per apical chromosome ($5.9 \pm 0.8 \times 10^6$ eV) is not significantly different from the energy absorbed per chromosome by other vegetative cells ($5.3 \pm 0.8 \times 10^6$ eV). Thus the apparent difference in tolerance disappears when energy absorption in the nuclei at the 100% lethal exposure is used as a measure of radiosensitivity. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 16264, 16266–16269, 16276–16278, 16355, and 16447.

16442 ON THE LETHAL AND PRE-MUTATIONAL DAMAGES INDUCED BY UV-RADIATION IN THE TEMPERATE PHAGE AR3 OF BACILLUS SUBTILIS AND ON THEIR REPARATION BY THE HOST CELLS. Azizbekyan, R. R.; Kriviskii, A. S. (Inst. of Molecular Biology, Moscow). Genetika, 5: 66-78(Jan. 1969). (In Russian).

Lethal damages to the phage AR3 of Bacillus subtilis was repaired by the system of dark reparation of the host-cells. The inhibition of the dark reparation decreased considerably the survival of the irradiated phage. The c-(clear) and l-mutants of the phage AR3 appeared in the course of segregation, either spontaneously or as the result of the extracellular irradiation. The l-mutants were characterized by the intense growth of lysogenized bacteria in the centre of the plaque. The uv-irradiation of the phage at a 250 erg/mm^2 dose resulted in a 2.5-fold increase of the frequency of c-mutants (on a hcr$^+$ lawn) and in a still greater, 7.5-fold increase of the l-mutants frequency. A ~2-fold increase of the frequency of spontaneous c-mutants on the hcr$^-$ and hcr$^+$ lawns with acriflavin (0.6 mkg/ml) was observed, the efficiency of plating being lower. It is assumed that lethal and premutaticnal damages initiate spontaneously in the course of replication of the non-irradiated DNA of the phage AR3. These damages are partially repaired in hcr$^+$ cells. When the hcr$^+$ strain and the strain with inhibited repairing capacity are infected with the irradiated phage the mutation frequency curves for c-mutants are almost parallel, which shows that, unlike lethal damages induced by uv-irradiation, pre-mutational uv-induced damages of the phage AR3 are not repaired by the hcr-system. The frequency of c-mutants was not increased by the uv-reactivation, although an almost 10-fold increase of the survival of the irradiated phage was ob-

served. It is assumed, that there are different molecular mechanisms of the reparation accomplished by B. subtilis for the pre-mutational and for the lethal damages of the phage, and that the spontaneous and the uv-induced damages resulting in c-mutations are of different nature. (auth)

16443 INACTIVATION OF LETTUCE NECROTIC YELLOWS VIRUS BY ULTRAVIOLET IRRADIATION. McLean, G. D.; Crowley, N. C. (Univ. of Adelaide). Virology, 37: 209-13 (Feb, 1969).

Lettuce necrotic yellows virus (LNYV) is approximately eight times more sensitive to ultraviolet irradiation than the U_2-strain of tobacco mosaic virus (TMV). The in vivo and in vitro dose-response curves of LNYV to ultraviolet irradiation are similar. When virus-inoculated half-leaves are irradiated at increasing intervals of time after inoculation with virus, the fraction of infection centers surviving increases with time, as found by other workers for TMV and tobacco necrosis virus. (auth)

16444 EXCISION OF PYRIMIDINE DIMERS IN VIVO AND IN VITRO. Setlow, R. B.; Carrier, W. L. (Oak Ridge National Lab., Tenn.). pp 134-41 of Replication and Recombination of Genetic Material. Peacock, W. J. (ed.). Canberra, Australia, Australian Academy of Science, 1968.

From International Conference on Replication and Recombination of Genetic Material, Canberra, Australia. See CONF-670822.

The properties of three systems for excision of pyrimidine dimers: Escherichia coli, T4 bacteriophage, and an in vitro system derived from Micrococcus lysodeikticus were measured. Cells labeled with ^{3}H-thymidine were uv irradiated and the DNA of the surviving cells was fractionated. Schemes illustrating the possible steps in the excision-repair of DNA in each system are diagrammed. (C.O.)

Radiosterilization and Radiopreservation

Refer also to abstract 16306.

16445 (COO-1183-27) INOCULATED PACK STUDIES ON CLOSTRIDIUM BOTULINUM TYPE E IN UNIRRADIATED AND IRRADIATED HADDOCK. Segner, W. P.; Schmidt, C. F. (Continental Can Co., Inc., Chicago, Ill.). [1968]. 27p. (CONF-681028-1). Dep. CFSTI.

From UJNR Conference on Toxic Microorganisms, Honolulu, Hawaii.

Inoculated packs were initiated to assess the public health aspect of Clostridium botulinum type E in irradiated and unirradiated haddock. Estimates of the maximal expected product storage life were determined by an untrained consumer-type panel. Values of storage life are designated as X and represent the time for unanimous product rejection by this panel. Triplicate samples per variable were inoculated with 10^6, 10^4, or 10^2 of the Beluga strain/g. Samples were given 0.1 and 0.2 MRad doses and incubated along with inoculated unirradiated controls at intervals from 50°F to 40°F. Toxin assays were conducted at fractions and multiples of X. At 40° and 42°F incubation, control and irradiated samples inoculated with 10^6 and 10^4 levels showed no toxin up to 2X. At 46°F incubation, samples inoculated with 10^6 spores and given 0.1 MRad irradiation showed toxin at X, but not earlier; controls remained nontoxic through 2X. Control and 0.1 MRad samples with a 10^4 inoculum showed no toxin development up to 2X. With 0.2 MRad irradiation, toxin was detected at 1/2X for both inoculum levels. At 50°F, control and 0.1 MRad irradiated samples were nontoxic up to X with 10^4 and 10^2 inoculum levels. However, 0.2 MRad samples showed detectable toxin at 1/2X and 3/4X with 10^4 and 10^2 inoculum levels. The results with 0.1 MRad appear encouraging, but the data with 0.2 MRad irradiation are less favorable. (auth)

16446 (COO-1689-2) RADIATION PASTEURIZATION OF FRESH MEATS AND POULTRY. Annual Report, February 15, 1967-February 14, 1968. Urbain, Walter M.; Giddings, George G.; Belo, Panfilo S.; Ballantyne, William W. (Michigan State Univ., East Lansing. Dept. of Food Science). Mar. 15, 1968. Contract AT(11-1)-1689. 80p. Dep. CFSTI.

Research efforts were focused on the three principal deteriorative processes that limit the salable life of fresh meats and poultry: fluid exudation (drip), color deterioration, and microbial spoilage. Although the work is incomplete, indications from the first year's effort are that the combination of ionizing radiation in the dose range of 50 to 150 kRad, plus refrigeration, polyphosphate treatment and effective packaging, and handling will provide the means for a centralized fresh meat cutting and distribution system. (auth) (C.O.)

16447 (THAI. AEC-9) PAPERS ON CERTAIN ASPECTS OF FOOD PRESERVATION, 6 SEPTEMBER 1966. (Office of Atomic Energy for Peace, Bangkok (Thailand)). 34p. (CONF-660963). Tiranasar Press, Bangkok, Thailand.

Separate abstracts were prepared for seven papers presented at the conference. (H.L.W.)

For abstracts of individual papers see: 16448-16454.

16448 (THAI. AEC-9, pp 1-4) FOOD PRESERVATION BY THE DEPARTMENT OF SCIENCE, BANGKOK. Disayamonthon, Virada; Sakornmongkon, Vichian (Ministry of Industry, Bangkok (Thailand). Dept. of Science).

Aims of the Department of Science are to promote and develop the food industry, to utilize the surplus of natural resources, to improve existing methods of processing, to develop new ones, and to study the problems involved in food preservation. Food preservation equipment was set up for research on canning, concentration of fruit juices, dehydration of foods, and for the assessment of quality of raw material and finished products. Fundamental research is carried out on the composition, properties, and bacteriology of foods. Training in technology is offered in the form of seminars, demonstrations, and practical work. The Department is collaborating with the Ministry of Public Health, the Preserved Food Organization, and other institutions in drafting of food legislation. (H.L.W.)

16449 (THAI. AEC-9, pp 6-18) RADIATION PRESERVATION OF LIMES AND MANGOES. Tengumnuay, Chongchit (Office of Atomic Energy for Peace, Bangkok (Thailand)).

Preservation of limes and mangoes by irradiation was studied. Waxing and the combination of waxing with gamma irradiation were investigated for possible prolonging shelf-life of limes. It was found that waxing alone extends the storage life of limes by about 28 days, while the combination of waxing with gamma irradiation gives an additional seven days. Irradiation destroyed vitamin C in limes as higher doses were given. A dose of 40 Krads delayed the ripening of mangoes by an average of 7 days at 70°F, lower doses were ineffective. (auth)

16450 (THAI. AEC-9, pp 19) RADIATION PRESERVATION OF BANANAS. Tengamnuay, Chongchit; Pholprasid, Pairoj; Rhodes, D. N. (Office of Atomic Energy for Peace, Bangkok (Thailand)).

In 1964 to 1965 work at the Thai AEC showed that doses of 10,000 to 50,000 rads extended the storage life of banana for about 10 to 12 days at 25°C. In recent experiments, in larger scale experiments using dose trials up to 50,000 rads, no delay of ripening (at 70 or 75°F) was found. The conflicting findings may be explained in the light of the work of Maxie et al (1966) who showed that irradiation of banana does not delay the maturation process if the fruit is damaged or the treatment is applied after the onset of the climacterie as measured by increasing respiration on ethylene production. Further experiment on round fruit at various stages of maturity will be necessary to make certain that a varietal difference is not involved. (auth)

16451 (THAI. AEC-9, pp 20-2) SOME ASPECTS OF TASTE PANEL EVALUATION OF IRRADIATED FISH. Tengumnuay, Chongchit (Office of Atomic Energy for Peace, Bangkok (Thailand)).

The use of a taste panel as a laboratory method to determine the acceptability of fish is described. Chub mackerel, treated at doses from 0.3 to 3.0 Mrads, showed no detectable change in flavor; at 4.0 Mrads a highly significant change was observed. Irradiation causes chemical reactions in foods which, although very small in amount, form highly odoriferous substances such as hydrocarbons, aldehydes and ketones, causing noticeable changes in the odor and flavor of the foods. Such changes are roughly proportional in intensity to the dose of radiation applied and it is important to determine at what dose level the threshold of detectability of human tasters is reached. Dose levels below this level will then have no effect upon the flavor of the food and can be used without fear of lowering the quality of the product. (auth)

16452 (THAI. AEC-9, pp 23-5) RADIATION, INSECTS, AND FOOD PRESERVATION. Beard, R. L. (Office of Atomic Energy for Peace, Bangkok (Thailand)).

A general discussion is presented of the significance of radiation control of insects. The radiosensitivities of the egg, larva, pupa, and adult are compared. The effects of radiation dose on various stages of the life history are discussed. Radiosterilization of stored food products, such as cereal grains and dried fruits, is discussed. It is pointed out that relatively low doses are required to destroy the eggs, while a dose of 100,000 rads

may be required to destroy the adults. The sterile male technique is described and its effectiveness in protecting livestock and food crops is discussed. (H.L.W.)

16453 (THAI. AEC-9, pp 26-30) PUBLIC HEALTH ASPECTS OF FOOD IRRADIATION. Tanasugarn, Lek (Kasetsart Univ., Bangkok (Thailand). Dept. of Bacteriology).

The importance of Salmonella food infections and problems of control are discussed. Studies on cultures of various species of Salmonella from outbreaks of the disease are reviewed. Effects of various doses of γ radiation on counts of Salmonella species in ground beef are tabulated. It is concluded that Salmonellae are moderately sensitive vegetative bacteria, and that a radiation dose of $5 \cdot 10^5$ rads will cause a large reduction in their numbers. Spore-forming bacteria would require much larger doses for destruction. A dose of $20 \cdot 10^5$ rads is required to kill Bacillus megaterium, a contaminant of fresh beef. A dose of $40 \cdot 10^5$ rads is required to kill the foot-and-mouth disease virus. (H.L.W.)

16454 (THAI. AEC-9, pp 31-4) FOOD PRESERVATION AND ITS PROBLEMS. Bhumiratana, Amara (Preserved Food Organization, Bangkok (Thailand)).

Methods of preserving raw fruit, vegetables, and meats and problems of obtaining food engineering personnel are discussed. Other problems considered are average income of the consumer, percent of income spent for food, eating habits, nutrition education of consumers, bacterial standardization, and storage times and temperatures. (H.L.W.)

16455 RADIATION STERILIZATION OF MEDICAL DEVICES AND SUPPLIES. 3. THE EFFECT OF IRRADIATION ON THE BRAID SILK SUTURES AND THE PROPERTIES OF SILICONE GRAFTED SILK SUTURES. Sato, Kenji; Ito, Nobuo (Tokyo Metropolitan Isotope Research Center). Eisei Kagaku, 13: 281-4 (Oct. 1967). (In Japanese).

Braid silk sutures (size, 2-0) pretreated or non-pretreated with silicone (Toshiba Co., TSF 484) were subjected to gamma radiation and effects of irradiation on the tensile strength and the solubility of the sutures were investigated. The degree of water repellence was compared in siliconized sutures treated with γ radiation and with heat. The tensile strength of the sutures was decreased with increasing radiation dose, but no difference was observed between the strength of the sutures irradiated at sterilization doses (2.5 Mrad) and that of the sutures autoclaved. No significant decrease was observed in the water repellence of the grafted sutures for long boiling and for immersion in storage solution (ethanol or carbolic acid). Silicone grafted sutures sterilized by irradiation seems to be a promising new technique. (NSA of Japan)

16456 RADIATION STERILIZATION OF MEDICAL DEVICES AND SUPPLIES. 2. EFFECTS OF X-IRRADIATION ON THE ABSORBABLE SURGICAL SUTURES. Sato, Kenji; Ito, Nobuo (Tokyo Metropolitan Isotope Research Center). Eisei Kagaku, 13: 277-81(Oct. 1967). (In Japanese).

Catguts (Type A and Type C, size, 2-0) sealed into various solution were used in this experiment. The tensile strength of the guts decreased with increasing dose, but the decreasing degree of strength by irradiation at the sterilizing dose 2.5 Mrad was less than 10%. No significant difference was observed in the tensile strength between the guts irradiated after sealing into isopropyl alcohol, xylene, or toluene, and the guts sealed into isopropyl alcohol after irradiating in dry state. Absorbency of the irradiated guts was examined by measuring the tensile strength after the immersion in artificial gastric juice or rabbit serum in comparison with the non-irradiated guts. There was no difference in the tensile strength between irradiated and nonirradiated guts. The sterilizing dose was determined by using the guts and the paper contaminated with Bacillis subtilis PC 1219 spores. Even the samples contaminated with 10^6-10^7 spores were sterilized at a dose level of 2.5 Mrad. Decreasing radioresistance of the spores was observed with increasing time in isopropyl alcohol. (NSA of Japan)

16457 IRRADIATION OF FISH FILLETS: RELATION OF VAPOR PHASE REACTIONS TO STORAGE QUALITY. Spinelli, J.; Dollar, A. M.; Wedemeyer, G. A.; Gallagher, E. C. Int. J. Appl. Radiat. Isotop., 20: 167-75(Mar. 1969).

Fish fillets irradiated under air, nitrogen, oxygen, or carbon dioxide atmospheres developed rancidlike flavors when they were stored at refrigerated temperatures. Packing and irradiating under vacuum or helium prevented development of off-flavors during storage. Significant quantities of nitrate and oxidizing substances were formed when oxygen, nitrogen, or air were present in the vapor or liquid phases contained in a Pyrex glass model system exposed to ionizing radiation suppled by a ^{60}Co source. It was demonstrated that the delayed flavor changes that occur in stored fish fillets result from the reaction of vapor-phase radiolysis products and the fish tissue substrates. (auth) (UK)

16458 PRESERVATION OF FRUITS AND VEGETABLES BY IRRADIATION. Zeeuw, D.; van Kooy, J. G. (EURATOM-ITAL, Wageningen, Ger.). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.), Suppl. No. 73, 12-15(Sept.-Oct. 1968). (In French).

The chemical and physiological effects produced by ionizing radiation on fruits and vegetables are examined. The effects of radiation on molds, yeasts, and insects are also considered. The present applications of irradiation techniques to foods and vegetables are outlined. The conditions which make a food acceptable for human consumption are outlined and the foods presently acceptable after irradiation are tabulated. (J.S.R.)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

16459 A REPORT OF THE SURVEY ON SPECIAL ELEMENTS. Kagaku Gijutsu-cho Shigen Chosa-kai Hokoku, No. 44, 122-5; 153-67; 256-63(Jan. 1968). (In Japanese).

A survey of special elements including thorium, titanium, and uranium is described. Domestic nuclear fuels and other materials are also described. For the former, the survey indicates minerals, producing areas, consumption, exports, imports, and Japanese production uses, enterprises, and customs duty. Also included in the survey are uranium fuels, nuclear fuel cycles, uranium enrichment, fuel fabrication, research and development on power reactor fuels, uses of domestic fuels, fabrication of cladding, and fuel reprocessing. (NSA of Japan)

Corrosion and Erosion

Refer also to abstracts 15835 and 17281.

16460 (BNWL-746, pp 9.1-5) FUEL SUPPORT-PROCESS TUBE INTERACTION. O'Keefe, D. P. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Fretting corrosion occurs in the inside of the Zircaloy-2 pressure tubes of the PRTR due to the relative motion of the fuel element assemblies in the tubes. The amount of fretting corrosion is a function of the design of the fuel element support hardware and of the flow conditions. The results of a 3 yr surveillance program which included periodic in-reactor visual examinations of the internal surface of the tubes showed that a variety of fuel element weights, length, and pad design can be irradiated in the PRTR without undue damage to the process tubes if adequate fuel element designs are utilized and normal PRTR operating conditions are applied. (L.C.L.)

16461 (CEA-CONF-1198) TREATMENT OF BREEDER REACTOR FUELS. ATTACK OF STAINLESS STEEL CANS BY HF-O_2 MIXTURES AND FUEL OXIDATION. Bourgeois, M.; Cuer, J. P.; Cochet-Muchy, B. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1967]. 25p. (In French). (CONF-681040-2). Dep.

From Symposium on Nonaqueous Reprocessing, Mol, Belgium.

Studies were made on the attack of stainless steel by the mixture HF-O, treatment of pellets of UO_2 frits by the mixtures HF-O and O-N, and decladding and pulverization of UO_2 fuels clad with stainless steel. Results on reaction mechanisms showed that stainless steel is only slightly attacked if the reagents HF and O_2 are passed through successively. The effects of the mixture HF-water vapor were identical to that of pure HF. The pulverization of pellets of UO_2 frit and their transformation require at 600°C a treatment of $1\frac{1}{2}$ hours by the mixture O-N containing 55% O. Decladding of the samples required 1 hr 15 min to 1 hr 30 min, which showed the reproducibility of the openings of the cans. The temperature used for decladding was 20 to 80°C; and 40°C for pulverization. (P.C.H.)

16462 (EUR-4098) STABILITY AND COMPATIBILITY OF HYDROGEN BARRIERS APPLIED TO ZIRCONIUM ALLOYS. Brossa, F.; Coen, F.; Schleicher, H. W.; Volta, G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Sept. 24, 1968. 42p. Dep.

Coatings to protect against hydrogen pick-up by Zircaloy 2 in contact with terphenyl were tested. Methods of deposition of coatings and their efficiency as hydrogen diffusion barriers are described. It was found that the most promising barrier against hydrogen diffusion is an Al-Si coating. Results of compatibility tests between Al-Si and Zircaloy 2 are reported. Methods to obtain efficient coatings on laboratory scale are described. (auth)

16463 (EURFNR-569) COMPATIBILITY OF HIGH MELTING METALS WITH URANIUM DIOXIDE. Vollath, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung). Translation of report KFK-762. 33p. Dep. CFSTI.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

Tests were performed to determine the compatability of Mo, Ta, W, and Mo-W and Re-W alloys with single-phase UO_{2-x}. The test equipment and procedures are described. The results show that the destruction of materials in the presence of UO_{2-x} occurs either, as in the case of tantalum, by the formation of a new low-melting phase or, as with W and W-containing alloys, by the coating of the grain boundaries with UO_2. Under thermal cycling this can lead to the detachment of the grain boundaries and would appear to severely limit the application of W and W-containing alloys. The metals Mo and Re are somewhat better. Coating of the grain boundaries with UO_2 can occur with Mo in some cases, but material loss of Re due to diffusion into the UO_2 is virtually negligible. However, since there is possibly a monotectic UO_2-rich liquid phase in these metals, there is a danger of increased material transport taking place over this melt which might possibly lead to serious material losses. It is concluded that the problem of compatability differs depending on the type of application envisaged and that data given in the literature can only be used after experimental verification for the special conditions required. (L.C.L.)

16464 (UCRL-Trans-10326) CORROSION PROBLEMS OF CARBON DIOXIDE-COOLED POWER REACTORS. Rypar, V. Translated by V. Nefton for Univ. of California, Lawrence Radiation Lab., Livermore, from Jad. Energ., 6: 192-9(1960). 39p. Dep. CFSTI.

The extent and importance of corrosion problems arising in the construction of nuclear reactors, and also with the specific features of these problems are considered. The chemical effects of the coolant gas and the kinetics of gas-reactor material interactions are analyzed. The oxidation of steel and of magnesium alloys is of special interest. The individual sections are concluded by discussion of methods designed for the protection of the principal parts of the reactor against corrosion by the coolant. An abstract of this paper, prepared from the original language, appeared as NSA 14: 18130. (auth)

16465 (WAPD-Trans-112) OXIDATION OF ZIRCONIUM IN A CARBON DIOXIDE ATMOSPHERE. Guerlet, J. P.; Lehr, P. Translated for Bettis Atomic Power Lab., West Mifflin, Pa., from Mem. Sci. Rev. Met., 62: 151-62(1965). 31p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 19: 22904.

16466 CORROSION RESISTING CHEMICAL PLANT FROM METAL EXPLOSION-CLAD WITH TANTALUM. Chelius, Jack (N. V. Fansteel Hoboken S.A., Hoboken, Belgium). Werkst. Korros., 19: 307-12(Apr. 1968). (In German).

Explosion-cladding of a 20-liter steel autoclave with Ta is described. The cladding is 0.75 mm thick on 12.5 mm carbon steel plate; ultrasonic tests showed perfect bonding over >98% of the plate area. The process does not involve the formation of intermediate layers, and is independent of the base metal. The Ta layer is pure and uniform in thickness. The compound product has high shear and flexural strength, and a heat transfer coefficient much greater than that of enameled steel. (F.S.)

16467 PASSIVITY AND PROTECTION OF METALS AGAINST CORROSION. Tomashov, Nikon D.; Chernova, Galina P. New York, Plenum Press, 1967. 222p. $14.00.

Translation of Passivnost' i Zashchita Metallov ot Korrozii by Boris H. Tytell.

A modern theory of the passive state in metals, involving the kinetics of the passivation process and theoretical research related to industrial applications, is presented. Studies of the quantitative relationships involved in the kinetics of corrosion processes in both metals and corrosive media are described. The information is presented under the following headings: the phenomenon of passivity in metals; passive systems; basic principles for increasing the corrosion resistance of alloys by increasing their passivity; anodic protection; passivation of metals by contact with cathodes; and passivation of metals by the introduction of oxidizers into the corrosion medium. (R.C.K.)

16468 AQUEOUS CORROSION OF THE ZIRCALOYS AT LOW TEMPERATURES. Kass, S. (Bettis Atomic Power Lab., West Mifflin, Pa.). J. Nucl. Mater., 29: 315-21(Mar. 1969).

Corrosion test results with Zircaloys-2 and -4 in degassed deionized water at 232 to 316°C have suggested that the pretransition corrosion follows a cubic relationship with exposure time. The cubic rate constant was found to vary regularly with temperature. The generalized equation for pretransition corrosion was found to be: $(\Delta W)^3 = 6.357 \times 10^{11} \exp(-13{,}640/T)t$. This equation represents the best statistical correlation and is useful for the prediction of long-time low-temperature corrosion behavior. (auth)

16469 CORROSION PROBLEMS OF ALUMINUM IN THE NUCLEAR REACTOR OF KINKI UNIVERSITY AND COUNTER-

MEASURES AGAINST THEM. Kokubo, Sadajirou; Furushima, Kazuyoshi (Kinki Univ., Japan). Kinki Aruminyumu Hyomenshori Kenkyukai Kaishi, No. 19, 4-12(Sept. 1968). (In Japanese).

The Kinki University reactor is a light water moderated, graphite reflected, inhomogeneous, thermal neutron type, with an output of 0.1 W. Plate type MTR fuel elements are enclosed with aluminum. Two core tanks are rectangular and made of aluminum. The light water moderator is open to the air at the top. The reactor reached criticality in November, 1961, and started its steady operation from May, 1962. Corrosion was found on the surfaces of the fuel plates in July, 1962. A White suspension appeared, bubbles came out in the moderator, and corrosion products were found on the surfaces of the fuel plates. About 5 ppM of ortho-phosphoric acid was added to the moderator. Ph value and electric conductivity of the moderator were measured once every week, and the moderator was purified with ion exchange resin once every two weeks. In July, 1967, pitting was again found on the surfaces of the fuel plates, which faced the core tank wall, and a white suspension of aluminum phosphate was found on the moderator surface. The corrosion behavior of aluminum in phosphoric acid solution, and effects of addition of fluorine or fluorides on protection of aluminum in highly pure water were investigated. It is desirable to purify cooling water by ion exchange for 250 hours after addition of phosphoric acid. Corrosion was not detected at 1500 hours after using fluoride. (NSA of Japan)

16470 CORROSION RESISTANCE OF HEAT-TREATED ZIRCONIUM ALLOYS. Ind. Heat., 35: 1246; 1243(July 1968).

Zirconium alloys containing 0.6% Fe and 3.1% Ni, or 1.1% Cu and 0.7% Fe were subjected to various rolling, quenching and aging treatments and then tested for corrosion resistance in superheated steam at above 500°C. Results show that a higher total alloy content produces a lower corrosion rate. Quenched material has a lower corrosion rate for short periods but the structure is not stable. Corrosion rate is not affected by steam flow rates up to 300 fps at 650°C and is insensitive to pressure up to 600 psi. The presence of 30 ppM of O_2 or a mixture of 30 ppM O_2 and 3.75 ppM H_2 in the steam at 650°C and 600 psi does not affect corrosion rate. (L.C.L.)

Preparation and Fabrication

Refer also to abstract 16466.

16471 (BNWL-746, pp 4.1-6) PROCUREMENT. Evans, R. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The procurement of Zircaloy-2 pressure tubes for power reactors is discussed in terms of: existing specifications for material and for tube fabrication; recommended changes in such specifications; fabrication procedures and products; and the companies which currently produce zircaloy pressure tubes. (L.C.L.)

16472 (BNWL-746, pp 8.1-7) TRANSITION JOINTS BETWEEN ZIRCALOY-2 AND PRIMARY COOLING SYSTEM. James, L. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The design and performance of leak free transition joints for joining Zircaloy-2 to standard piping materials, usually stainless steels, used in the primary cooling system of reactors are discussed. Methods used in forming the joints include: fusion welding, brazing, diffusion bonding, rolling, and explosive bonding. (L.C.L.)

16473 (ORNL-4354) METALLOGRAPHIC PREPARATION OF ARC-CAST THORIUM CARBIDES AND CORRELATION OF THEIR MICROSTRUCTURES WITH COMPOSITION. Sears, Mildred Bradley; Kegley, T. M. Jr.; Ferris, Leslie M.; Leslie, B. C. (Oak Ridge National Lab., Tenn.). Mar. 1969. Contract W-7405-eng-26. 41p. Dep. CFSTI.

Arc-cast thorium carbide specimens with C/Th atom ratios varying from 0.8 to 2.1 (4.0 to 10.0 wt % carbon) were prepared for metallographic examination, and their microstructures were correlated with the chemical analyses, the x-ray diffraction analyses, and the products of hydrolysis. The thorium monocarbide phase was found to exist over a range of composition from about $ThC_{0.94}$ (4.6% carbon) to at least as low as $ThC_{0.81}$ (4.0% carbon). Specimens with compositions from $ThC_{0.99}$ to $ThC_{1.88}$ (4.8 to 8.8% carbon) were two-phase mixtures of the mono- and dicarbides at room temperature. The maximum combined-C/Th atom ratio obtained by arc-melting with graphite electrodes was 1.96 (9.2% carbon). There was no evidence for any significant range of composition for the dicarbide at room temperature. A new metallographic procedure with several advantages over air-etching contributed significantly to the study. A solution containing equal parts (by volume) of nitric acid (70 wt %) and water was used to passivate and etch thorium dicarbide and two-phase thorium dicarbide-monocarbide specimens. Single-phase thorium monocarbide specimens were prepared for metallographic examination by an attack-polish procedure, using dilute nitric acid and 0.3-μ-dia alumina. (J.G.B.)

16474 METHOD OF PRODUCING ALLOYS OF ZIRCONIUM WITH IRON, VANADIUM, AND CHROMIUM FOR USE IN NUCLEAR REACTORS COOLED WITH AN ORGANIC COOLANT. Imarisio, Giancarlo (to EURATOM). U. S. Patent 3,427,210. Feb. 11, 1969. Priority date July 27, 1966, Germany.

A method of producing structural parts for nuclear reactors from alloys of zirconium with chromium, iron, and vanadium is described. The process involves the steps of twice melting the alloying constituents in a furnace, forging the alloy at about 1000°C, annealing at about 1000°C, quenching, repeating the forgina, annealing and quenching, hot rolling, tempering, and cold rolling. (Offic. Gaz.)

16475 ZIRCONIUM BASE ALLOY. Lovell, C. N. (to United States Atomic Energy Commission). U. S. Patent 3,431,104. Mar. 4, 1969.

A zirconium based alloy having a high resistance to corrosion in superheated steam at 400 to 650°C and having a high resistance to hydrogen absorption and low susceptibility to hydrogen embrittlement is described. The alloy consists essentially of a copper content in the range of about 1.5 to 1.7 at. %, an iron content in the range of about 0.35 to 0.55 at. %, with the remainder zirconium. In addition, a structure can be produced from the alloy having even greater improved corrosion reistance by treating, working and fabricating the alloy at temperatures below 765°C. (AEC)

16476 STUDY OF THE SOURCE OF EXOGENOUS INCLUSIONS IN STEEL BY RADIOACTIVE TRACERS. PART II. Logi, P.; Matteoli, L. (Istituto di Ricerche Breda, Milan). Met. Ital., 60: 805-14(Sept. 1968). (In Italian).

Work is reported on radioactive tracer measurements in steel plants, of the contribution of ladle refractory linings to non metallic inclusions in steel. Thulium-170 was selected as radioactive tracer and a method was set up, giving simple and low cost operations, and good protection from ionizing radiations. The following tests on industrial scale, with different tagging of ladle refractory linings, have been performed: 5 heats, with a 5 ton ladle entirely tagged and pouring of five 4 ton ingots; 11 heats, with 22 ton ladles, bottom pouring of 3 plates of 4 ingots each, alternate tagging of bottom, walls and nozzle of the ladles; 3 heats, with a 50 ton ladle entirely tagged and pouring of twelve 4.8 ton ingots from each heat. The content of radioactive inclusions was determined, by radiometric analysis, for several positions of the ingots. All tests showed that the refractory materials are the origin of a small quantity of inclusions, generally less than 1 ppM. The results of the determinations are given and problems related to the use of radioactive tracers in industrial plants are discussed. (auth)

16477 ON THE CARBIDOTHERMIC PRODUCTION OF METALS OF GROUPS IVa, Va, AND VIa, AND THEIR ALLOYS. Kieffer, Richard; Lihl, Franz; Effenberger, Erwin (Technische Hochschule, Vienna). Z. Metallk., 60: 94-100(Feb. 1969). (In German).

A carbidothermic method for the production of the vanadium and chromium is described which yields metals of remarkable purity. The atom ratio C/O may be taken into account in the initial mixture for the production on a technical scale such that a product with a minimum content of residual (C/O) is obtained. The process of indirect sintering in conjunction with subsequent direct sintering may be applied for the production of large quantities. The process of carbidothermic production is not suitable for group IVa metals. It is not possible to transfer the carbooxide into a metal by conventional means. The carbidothermic process may be employed for the production of alloys if the following considerations are taken into account: Binary and ternary alloys of group Va and group VIa metals may be produced by the oxide-carbide reduction technique in any case. Even though these systems exhibit low-melting eutectics these are disadvantageous only in the case of vanadium base alloys. With increasing content of VIa metals the process is increasingly more favorable because of shorter sintering times. Alloys containing group VIa components should not contain more than 50 at.-% in the case of Ti and should not exceed 30 at.-% in the case of Zn and Hf. For group IVa base alloys (e.g. 70 to 80% Ti) the IVa metal has to be added in a pure form and in a corresponding amount to the oxide-carbide mixture in the last stage of reaction. (tr-auth)

16478 NUCLEAR REACTOR FUEL ELEMENTS. Lining, David Lees (to United Kingdom Atomic Energy Authority). U. S.

Patent 3,421,979. Jan. 14, 1969. Priority date Dec. 23, 1965, Great Britain.

A fuel element for a fast nuclear reactor is described which has a ceramic fuel in metallic sheathing. The fuel is divided into a central zone and an outer zone or interlayer interposed contiguously between the central zone and the sheath. The fissile fuel is predominantly in the central zone while the fertile fuel is predominantly in the interlayer which has thermal insulating properties whereby the operating temperature of the fuel can be increased so as to lower its compressive creep resistance to enable irradiation-induced swelling of the fuel to be absorbed in voidage distributed in the fuel by virtue of its aggregated density being arranged to be less than (for example 85% of) maximum theoretical density. Where plutonium fissile atoms are employed, they are included in the central zone, while the interlayer is of natural or depleted uranium. (L.C.L.)

Properties Evaluations

16479 (BNWL-746) ZIRCALOY-2 PRESSURE TUBING. Knecht, R. L.; Pankaskie, P. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec. 1968. Contract AT-(45-1)-1830. 179p. Dep.

Ten papers on the present state of Zircaloy-2 heavy water reactor pressure tube technology are presented. Separate abstracts were prepared for each. (L.C.L.)

For abstracts of individual sections see: 16460, 16471, 16472, 16480–16484, 16498, and 16499.

16480 (BNWL-746, pp 3.1-5) DESIGN BASIS. Ostrom, T. R.; Evans, R. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The design criteria used for zirconium alloy reactor pressure tubes in all Canadian power reactors, the Steam-Generating Heavy-Water-Moderated Reactor in the U.K., and the Carolina-Virginia Tube Reactor in the U. S. are explained. These criteria were based on the intent of the ASME pressure vessel code. Since zirconium alloys are uncoded materials and since uniaxial, unirradiated material strength was used in applying the code criteria with no allowances for the effects of neutron irradiation, general modification of the design criteria are recommended which will result in economies due to the increased strength of Zircaloy-2 under actual pressure tube operating conditions. (L.C.L.)

16481 (BNWL-746, pp 5.1-16) STRESS RELATED PROPERTIES OF PRESSURE TUBING. Ostrom, T. R.; Evans, R. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Test data on the stress related properties of Zircaloy-2 pressure tubing, both annealed and cold-worked, used in various power reactors are compiled and compared. These properties include: creep and stress rupture; burst strength and ductility as a function of temperature; and crack propagation and fatigue stress. Also included are the effects of fabrication methods and of hydrogen on the mechanical properties of zircaloy tubes. (L.C.L.)

16482 (BNWL-746, pp 10.1-31) OPERATIONAL STANDARDS AND SURVEILLANCE. Pankaskie, P. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The unprecedented use of Zircaloy-2 pressure tubes in power reactors in Canada, the U. S., and U. K. provided the incentive for undertaking pressure tube surveillance programs at several of these reactors. The surveillance programs consist of periodic in-reactor inspections and destructive testing and evaluation of pressure tubes removed at specific increments of service. A description is given of tube related operational standards and the surveillance programs in effect at the various reactors and of the instrumentation used for in situ pressure tube inspections. (L.C.L.)

16483 (BNWL-746, pp 11.1-5) RELIABILITY AND SENSITIVITY ANALYSIS. Turley, R. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A literature survey was conducted to obtain information on reliability and sensitivity analysis for the design of reactor pressure tubes. Reliability analysis requires data on the causes, modes, stresses, time, and environmental effects of pressure tube failures. Sensitivity analysis of the design of pressure tubes accounts for the effects of design variables on the performance of the pressure tubes. It is concluded that little information for these analyses is available, primarily because there have not been sufficient failures from which to gather such information. (L.C.L.)

16484 (BNWL-746, pp 12.1-38) OTHER PRESSURE TUBE MATERIALS. Pankaskie, P. J.; Gilbert, E. R.; Wheeler, K. R.; Shober, F. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The effects of fast neutron flux, testing temperatures, and fabrication methods on the mechanical properties of several candidate materials for reactor pressure tubes are described and test results tabulated. These materials include: Zircaloy-2, Zircaloy-4, niobium–tin–Zirconium-base alloy, niobium–zirconium-base alloy, aluminum–chromium–iron-base alloys, aluminum–chromium–iron–yttrium-base alloy, and AISI Type 410 stainless steel. The effects of these same variables on the burst strength, creep and stress rupture strength, fatigue crack growth, and crack propagation properties of pressure tubing made from most of these materials are also presented. (L.C.L.)

16485 (ORNL-TM-2089) THERMAL FATIGUE OF ROCKET NOZZLE COOLING TUBES. Harman, D. G. (Oak Ridge National Lab., Tenn.). Feb. 1969. Contract W-7405-eng-26. 52p. Dep. CFSTI.

Procedures were developed for testing the thermal fatigue resistance of coolant tubes in regeneratively cooled rocket nozzles of the type used in nuclear rocket engines. Specimens of Type 347 stainless steel and Hastelloy X were cycled between −200 and 1600, 1800, and 1900°F. Fatigue failures in the form of intergranular cracks were observed through the tube crowns after 23 to 87 thermal cycles. The number of cycles to failure depended upon the severity of the thermal cycle (temperature difference and hold time at maximum temperature) and the geometry of the test specimen. Fatigue life was decreased by increasing the maximum temperature (larger temperature difference), holding at this temperature for longer times, or denting the tube crowns before test. Fatigue life increased with decreasing tube diameter, and this observation was applied to the analysis of a typical nozzle configuration. No appreciable difference was noted between the behavior of Type 347 stainless steel and the Hastelloy X test specimens, if the ratio of tube radius to thickness was considered. (auth)

16486 (ORO-2413-18(App.2)) DISLOCATION-INTERSTITIAL INTERACTIONS IN SINGLE-CRYSTAL TANTALUM. Sanders, Richard C.; Turner, Thomas J. (Wake Forest Univ., Winston-Salem, N. C.). Sept. 23, 1968. 16p. (CONF-680910-8). Dep. CFSTI.

From International Conference on Vacancies and Interstitials in Metals, Juelich, Germany.

The amplitude dependent (hysteretic) decrement of high purity single-crystal tantalum has been measured with a composite oscillator operating at approximately 50 kHz at 200 to 400°K. Linear Granato-Lücke plots were obtained whose slopes give a binding energy for oxygen to the dislocation of 0.025 eV. This appears unrealistic since it is smaller than kT for some temperatures employed. Assuming an Arrhenius temperature dependence for the hysteretic decrement a stress dependent binding energy was obtained. The data extrapolate to a zero stress binding energy of 0.27 eV and a maximum breakaway stress of 2.7×10^8 kg/m^2. A high temperature modification to the Granato-Lücke theory utilizing a force approach was found to be inadequate for this system. (auth)

16487 (UUIP-614) CYCLIC QUENCHING OF PURE ALUMINUM, A SIMPLIFIED MODEL OF THERMAL FATIGUE. Wiberg, J.; Bergstroem, Y.; Vingsbo, O. (Uppsala Univ. (Sweden). Inst. of Physics). Nov. 1968. 16p. Dep.

Very small specimens of pure aluminum with a high initial vacancy supersaturation were subjected to a cyclic thermal treatment, each cycle including heating to 170°C. The resulting dislocation structure was studied by electron transmission microscopy. Intrinsic dislocation loops were found after less than 10 cycles. After less than 4 cycles all loops were prismatic. After 4 cycles 80% of the loops were Frank sessile, which fraction then decreased with increasing number of cycles. The result is interpreted as due to a cyclic "vacancy pump" effect of the dislocation loops. (auth) (Sweden)

16488 METAL–SEMICONDUCTOR TRANSITION IN YTTERBIUM AND STRONTIUM AT HIGH PRESSURE. McWhan, D. B.; Rice, T. M.; Schmidt, P. H. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 177: 1063-71(Jan. 15, 1969).

It has been suggested that Yb and Sr undergo semimetal-to-semiconductor transitions under pressure. The electrical resistivity ρ was measured from 298 to 2°K at different pressures up to 50 kbar. In Yb, ρ at 4.2°K increases by a factor of 6×10^4 at P = 25 kbar and saturates at higher pressures. For P < 25 kbar, the empirical relation at 4.2°K is $\ln[\rho(P)/\rho(1\text{ atm})] = 0.45\ P$, where P is the pressure in kbar. At P = 25 kbar, the resistance ratio $\rho(4.2°K)/\rho(298°K) = 220$. In Sr the resistance rise is much less dramatic, ρ at 4.2°K increasing by a factor of 50 in 35 kbar. A small negative temperature coefficient of resistivity appears for $P \gtrsim 30$ kbar in Sr. It is suggested that Yb becomes a semiconductor at high pressures, whereas Sr remains a semimetal.

These conclusions are compatible with the band-structure calculations of Vasvari, Animalu, and Heine for the fcc alkaline-earth metals, if the effects of spin-orbit coupling are included. No evidence is found for either an excitonic phase or a first-order transition in the neighborhood of the semimetal-to-semiconductor transition at low temperatures. However, no definitive statements can be made because of impurity effects. The Yb sample was 99.99% pure according to emission-spectrographic analysis. At higher pressures both Yb and Sr showed the transition to the bcc phase, and in this phase both materials behaved as a good metal and showed no evidence of a magnetic transition. (auth)

16489 EROSION-RESISTANT SINTERED TUNGSTEN CARBIDE ALLOYS USED FOR DRILLING BITS. Herscovici, P.; Radu, S.; Bunescu, S.; Tanasescu, J. Cercet. Met., 9: 731-8 (1967). (In Rumanian).

The preparation and sintering conditions for WC alloys containing 6 to 12% Co were examined and the wear properties of the alloys under operating conditions are discussed. (auth)

16490 CONCENTRATION CHANGES IN BINARY METAL-GAS SOLUTIONS DURING SIMULTANEOUS REMOVAL OF GAS AND EVAPORATION OF METAL. II. DISCUSSION OF THE CONCENTRATION CHANGES IN THE SYSTEMS VANADIUM–OXYGEN, NIOBIUM–OXYGEN, TANTALUM–OXYGEN, VANADIUM–NITROGEN, NIOBIUM–NITROGEN, AND TANTALUM–NITROGEN. Hoerz, Gerhard (Max-Planck-Institut fuer Metallforschung, Stuttgart). Z. Metallk., 60: 121-6(Feb. 1969). (In German).

For thin samples the experimental results of investigations of the degasification kinetics in the systems vanadium-oxygen, niobium-oxygen, tantalum-oxygen, niobium-nitrogen and tantalum-nitrogen are summarized and compared with the results of the theoretical treatment of the concentration changes in metal-gas solutions during annealing. It is found, that in the systems niobium-oxygen, tantalum-oxygen, niobium-nitrogen and tantalum-nitrogen the metal evaporation is negligible during almost the whole degassing process up to the melting temperature. In the system vanadium-oxygen metal evaporation is negligible only during a part of the degassing process. In the systems vanadium-oxygen, niobium-oxygen, tantalum-oxygen, niobium-nitrogen and tantalum-nitrogen the final gas concentration down to which degassing is theoretically possible is determined by the partial pressures of the residual gases in the vacuum apparatus and not by the metal evaporation. Results of investigations of the degassing of vanadium-oxygen and vanadium-nitrogen melts by other investigators are discussed. (tr-auth)

16491 RECRYSTALLIZING BEHAVIOR OF REACTOR-PURE IODIDE ZIRCONIUM. Cyrener, Klaus; Mertsching, Arno (Institut fuer Metallkunde und Materialpruefung der Bergakademie, Freiburg i. B.). Neue Huette, 13: 674-7(Nov. 1968). (In German).

The recrystallization of iodide zirconium melted in an electron beam multichamber oven and hammer deformed was observed by resistance and microhardness measurements and by x-ray and micrograph studies. It was established that the recrystallization in the η range studied begins at about 400°C independently of the degree of deformation and ends at about 450°C. It is much below the α/β transformation temperature. (tr-auth)

16492 EFFECT OF TUNGSTEN ON THE MORPHOLOGY OF THE GAMMA-PRIME PRECIPITATE IN NICKEL-BASE ALLOYS. Havalda, Andrej. Kovove Mater., 6: 201-5(1968). (In Slovak).

The effect of W in Ni-alloys at various Ti : Al ratios and constant Cr content (20%), after homogenizing at 1200°C for 150 hr and prolonged annealing at 850°C for 1000 hr was studied. The effect of W is very marked, especially in alloys with a higher Ti content, where the precipitating particles otherwise have the cubic form. With increasing W content their shape changes gradually from cubic to spheroidal. After the heat treatment the coherent stresses cannot markedly affect the morphology or influence the deformation energy of the crystal lattice of the precipitate and the matrix. At this stage the morphology is primarily dependent on the elements forming the precipitate on the Al, Ti, W. and Cr contents (according to the type of alloy system), on the solubility of these elements in the precipitate, and on how a given element forming part of the structure of the precipitate affects its surface energy. No clear relationship was found between the size of the precipitating particles, the Ti : Al ratio, and the W content. The quantity of the precipitating phase was greater at a higher W content. (F.S.)

Structure and Phase Studies

Refer also to abstract 16486.

16493 THE CRYSTAL STRUCTURE OF A THORIUM–ALUMINUM ALLOY, Th_2Al_7. Frueh, A. J.; Sygusch, J. (McGill Univ., Montreal). Z. Kristallogr., 127: 139-44(1968).

Th_2Al_7 is an orthorhombic crystal, space group Pbam, with the following lattice parameters: a = 11.479 Å, b = 5.874 Å and c = 5.53 Å. Volume = 373.9 Å^3. The measured density of 5.40 g/cm^3 indicates a cell content of 2$(Th_2Al)_7$, which gives a calculated density of 5.80 g/cm^3. The atom parameters were determined from Patterson and electron-density projections, and refined by least squares using isotropic temperature corrections and correcting for anomalous dispersion. The four thorium atoms are on the 4(g), xy0, with x = 0.147 and y = .142, 8 Al atoms are on the general position 8i, xyz, with x = 0.410, y = 0.153, z = 0.238, 4 Al atoms are on 4h, xy$\frac{1}{2}$, with x = 0.248, y = 0.406, 2 Al atoms are on 2b; 00$\frac{1}{2}$. (auth)

16494 SOME OBSERVATIONS ON THE CRYSTAL STRUCTURES OF THE RARE EARTH METALS AND ALLOYS. Harris, I. R.; Raynor, G. V. (Univ. of Birmingham, Eng.). J. Less-Common Metals, 17: 336-9(Mar. 1969).

At room temperature, the elements from La to Nd have the double hexagonal structure, Sm (Z = 62) has a rhombohedral structure, and the elements Gd to Lu, except Yb, have the close-packed hexagonal (cph) structure. A correlation has been found between the axial ratios of the hexagonal rare-earth metals and alloys and the atomic number. (For intra rare-earth alloys, a mean atomic number Z_m is defined.) A plot of the axial ratio vs atomic number for the rare-earth metals of $57 \leq Z \leq 71$ and some binary Ce–rare earth alloys show a common curve with a sharp minimum at Z = 68–69. The cph structure in the alloys has a limiting Z_m of ~63.5. The alloys with the Sm-type structure exist at Z_m = 62 to 63. Reasons for the exceptions (Gd and Ce) to the correlation are discussed. (D.L.C.)

16495 CONTRIBUTION TO THE STUDY OF CERTAIN METASTABLE PHASES IN THE BINARY SYSTEM ZIRCONIUM–NIOBIUM. Guerillon, Jean-Pierre; Quivy, Annick; Lehr, Pierre (CNRS, Vitry-sur-Seine, France). Compt. Rend., Ser. C, 267: 1767-70 (Dec. 23, 1968). (In French).

The modes of decomposition of the solid solution β(Zr)–β(Nb) in the course of cooling are defined. Two alloys of 10 and 14% niobium underwent, after homogenization annealing in the β phase, an oil tempering, either direct or in stages after being maintained in the two-phase region, $\alpha + \beta$. The constituents of tempering and their evolution were studied by x-ray diffraction, micrography, and microhardness. (tr-auth)

16496 GALLIUM DIFFUSION IN DELTA-STABILIZED Pu–Ga ALLOYS. Rafalski, A. L.; Harvey, M. R.; Riefenberg, D. H. (Dow Chemical Co., Golden, Colo.). Contract AT(29-1)-1106. Amer. Soc. Metals, Trans. Quart., 60: 721-3(Dec. 1967). (RFP-1022).

Gallium diffusion parameters in delta-stabilized Ga–Pu alloys were redetermined by electron-probe microanalyses of diffused couples. The possibility that grain boundary diffusion might be affecting the results was also investigated. Measurements indicated the redetermined parameters which were slightly lower than those previously found are representative of volume diffusion. (F.S.)

Radiation Effects

Refer also to abstracts 16484, 17188, 17235, and 17263.

16497 (AERE-R-5837) ESTIMATION OF THE COMPOSITIONAL AND VOLUME CHANGES IN NOBLE AND REFRACTORY METAL ALLOYS DUE TO NEUTRON IRRADIATION. Braunton, C. B. T.; Hall, D. N.; Ryall, C. M. (Atomic Energy Research Establishment, Harwell (England)). Sept. 1968. 102p. Dep. CFSTI. UK 14s.

One problem in the selection of thermocouples for irradiation experiments is the possible variation of emf/temperature relationships during irradiation, caused by changes in composition due to transmutation. These changes were calculated for a number of refractory and noble metals and alloys for irradiation periods up to 375 days in termal neutron fluxes ranging from 10^{13} to 10^{15} n/cm^2/sec. It was concluded that all the materials investigated will suffer significant changes in composition during irradiation, and that both the thermoelectric and dimensional stability are therefore suspect. (auth)

16498 (BNWL-746, pp 6.1-10) RADIATION EFFECTS ON PRESSURE TUBE PROPERTIES. Ostrom, T. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Data on the effects of fast neutron irradiation on the creep, stress rupture, burst strength, ductility, and fracture properties

of Zircaloy-2 pressure tubes were compared for irradiated tubular specimens and for in-reactor tests. It is tentatively concluded that creep of Zircaloy-2 pressure tubes under irradiation is accelerated by a fast neutron environment, that secondary creep rate in-reactor depends on neutron flux intensity and tends to remain constant, whereas, for out-of-reactor tests, the secondary creep rate is constantly decreasing. Stress rupture data are inconclusive. Limited data on tubes removed from the PRTR show little irradiation effect on burst strength at room temperature, but an increase in burst strength of almost 20% at elevated temperatures. A slight reduction in ductility has been noted after fast neutron exposure, but further information on the effect of temperature is needed. Tests indicate little effect of irradiation on the crack propagation characteristics of Zircaloy-2 at temperatures up to 100°C. (L.C.L.)

16499 (BNWL-746, pp 7.1-34) RADIATION EFFECTS ON COUPON PROPERTIES. Shober, F. R.; Hoagland, R. G.; Claudson, T. T.; Gilbert, E. R.; Barker, R. W.; Lowell, H. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The effects of fast neutron flux on the mechanical and physical properties of annealed and cold-worked Zircaloy-2 at varying postirradiation annealing temperatures, testing temperatures, and irradiation temperatures up to 500°C are discussed with emphasis on properties such as creep, ductility, electric resistivity, fracture toughness, stress rupture, and yield strength. The effect of hydrogen on the fracture toughness of Zircaloy-2 is examined. (L.C.L.)

16500 (GEMP-668) OBSERVATION OF DAMAGE SHELLS IN IRRADIATED METALS. Rau, Robert C.; Ladd, Robert L. (General Electric Co., Cincinnati, Ohio. Missile and Space Div.). [nd]. Contract AT(40-1)-2847. 12p. (CONF-681107-3). Dep. CFSTI.

From 1st Annual Technical Meeting of the International Metallographic Society, Denver, Colo.

Transmission electron microscopy was used to study the microstructural effects of thermal neutron transmutation of segregated boron in A-286 and Hastelloy R-235 alloys, and in vanadium. These observations show the presence of shells of enhanced radiation damage surrounding boron-containing precipitates in these metals. The shells, which initially consist of defect clusters resulting from atom displacement cascades, are duplex in nature, having an inner damage region caused by recoiling lithium ions and an outer damage region caused by recoiling alpha particles. Post-irradiation annealing leads to the elimination of the defect clusters and replaces them with dislocations and gas bubbles. (auth)

16501 (N-68-33385) LOW-TEMPERATURE ANNEALING OF IRRADIATED COMMERCIALLY PURE TITANIUM. Schwanbeck, C. A. (Lockheed Nuclear Products, Marietta, Ga.). May 1968. Contract NAS3-10298. 52p. (NASA-CR-72428; LAC-ER-9887). CFSTI.

Results obtained in an experimental study of the effects of post-irradiation annealing at cryogenic temperatures on the tensile properties of commercially pure titanium (Titanium 55A-Annealed) are described. Test specimens were exposed to fluences of 6×10^{17} n/cm^2, with neutron energies greater than 0.5 MeV (80 femtojoules), at 17°K. The irradiated specimens were tested after annealing periods of one hour at 78 and 178°K. Parallel sample lots were tested at the annealing temperature and after recooling to 17°K. Additional specimens were tested at 17°K following irradiation at 17°K with no post-irradiation annealing period. The sample lots tested at 17°K following post-irradiation annealing showed that a pronounced reduction of the ultimate tensile strength occurred at temperatures below 78°K, while a less pronounced effect on the tensile yield strength occurred over the entire annealing temperature range. The sample lots tested at the post-irradiation annealing temperature showed a gradual reduction in the irradiation effect on the ultimate tensile strength over the range of test temperatures. This reduction was substantial while there was relatively little reduction in the yield strength. (auth) (STAR)

16502 (RD/B/N-1216) NON-LINEAR IRRADIATION GROWTH. Hesketh, R. V. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Lab.). Nov. 1968. 7p. Dep. CFSTI. UK.

The proportionality of irradiation growth to the square root of the neutron fluence which was observed by Kreyns (NSA 21: 1963) in Zircaloy-4 is explained by assuming that both vacancy and interstitial loops of appreciable size are formed, and that diffusion of mobile defects to these loops is important. Numerically the data give a growth coefficient similar to that given by the irradiation creep data ($G \propto 1$). (auth)

16503 REACTION BETWEEN POINT DEFECTS AND MAGNESIUM ATOMS IN ALUMINUM IRRADIATED BY NEUTRONS AT 78°K. Dimitrov, Colette; Minel, Lea; Dimitrov, Omourtague. (CNRS, Vitry-sur-Seine, France). Compt. Rend., Ser. C, 267: 1759-62(Dec. 23, 1968). (In French).

The addition of increasing concentrations of magnesium to pure aluminum produces, after irradiation by neutrons at 78°K, an increase in the range of the second restoration stage. This is proportional to the content of magnesium for low concentrations ($\leq 65 \times 10^{-6}$). Phase III, which already exists in pure aluminum, increases progressively, and the appearance of a small phase III′ is observed. By admitting that the increase of phase II is due to the liberation of trapped interstitial faults by the magnesium atoms in the course of irradiation, it is possible to calculate the interstitial-magnesium atom binding energy to be 0.29 ± 0.03 eV. (tr-auth)

16504 THE EFFECT OF THE FAST NEUTRON SPECTRUM ON THE RATE AND DISTRIBUTION OF DAMAGE IN ZIRCONIUM. Piercy, G. R. (Chalk River Nuclear Labs., Ont.). J. Nucl. Mater., 29: 267-84(Mar. 1969).

The damage rate produced by neutron irradiation of zirconium is calculated in terms of the energy given to the lattice. The effects of anisotropic elastic neutron scattering, inelastic neutron scattering, and energy loss to electron excitation using Lindhard's theory, are included. The results are applied to correlate the damage rate in seven different reactor spectra in terms of the associated ^{58}Ni monitor activity. The number of damage regions as a function of their lattice energy is also estimated and applied to several experiments. (auth)

16505 ORIENTATION AND TEMPERATURE DEPENDENCE OF ELECTRON DAMAGE IN n-TYPE GERMANIUM. Chen, Y.; MacKay, J. W. (Purdue Univ., Lafayette, Ind.). Contract AT(11-1)-125. Phil. Mag., 19: 357-69(Feb. 1969).

The energy dependence of defect production in n-type Ge was studied at 78 and 269°K for electron irradiation parallel to ⟨111⟩ and ⟨100⟩ crystallographic directions. Up to 900 keV irradiation in the ⟨111⟩ direction resulted in greater defect production than irradiation parallel to ⟨100⟩. Damage production was higher at 269 than at 78°K, but the orientation dependence was much smaller. The orientation effect vanished at 340 keV. A maximum ratio between ⟨111⟩ and ⟨100⟩ damage production was found near 450 keV; a reversal occurred near 900 keV. It is suggested that the observed isotropic damage production at the lowest energy for which defect production can be detected may be an indication that there exists a lower displacement threshold corresponding to a nearest interstitial site along the ⟨111⟩ direction, as postulated by by Kohn (1954). (auth) (UK)

16506 ELECTRON MICROSCOPIC OBSERVATION OF NEUTRON-IRRADIATED GERMANIUM. den Ouden, G. (Univ. of Illinois, Urbana). Contract AT(11-1)-1198. Phil. Mag., 19: 321-4(Feb. 1969).

Single crystals of germanium irradiated with fast neutrons were studied by means of transmission electron microscopy. Irradiated specimens showed defects that had a size distribution with a tail extending to larger sizes and a most probable diameter of 38 Å. The contrast of the defects was found to depend on the diffraction conditions and suggested that the defects were associated with a strain field. (auth) (UK)

16507 HYDROGEN ACCUMULATION AT STACKING FAULTS BY DE-CHANNELING IN ALUMINIUM. Thomas, G. J.; Venables, J. A. (Univ. of Sussex, Eng.). Phil. Mag., 19: 325-9 (Feb. 1969).

After bombardment of aluminium with 1 keV protons, rows of prismatic loops were observed, which radiated from previously quenched-in faulted vacancy loops. Evidence is presented that strongly suggests that these rows are caused by a prismatic punching process initiated by the build-up of a hydrogen gas pressure at the vacancy loops, caused by dechannelling of protons at the stacking faults. (auth) (UK)

Ceramics and Cermets

Preparation and Fabrication

Refer also to abstracts 15864, 15950, 15951, 16012, 16535, 16552, and 17188.

16508 (EURFNR-572) VAPOR CHROMIUM PLATING OF UO_2 AND Al_2O_3 PELLETS. Schneider, H.; Schoenwald, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung). Translation of report KFK-787. 19p. Dep. CFSTI.

Work performed under United States–Euratom Fast Reactor Exchange Program.

A method for chromium carbide and metal chromium plating of UO_2 and Al_2O_3 pellets in a fluidized bed is described. Heat decomposition of dicumenechromium without a catalyst yielded chromium carbide (Cr_7C_3) coatings with approx. 10% C, the vapor-deposited chromium on batches of 50 g Al_2O_3 amounting to up to 20 vol %. When iodine was used as a catalyst, heat decomposition of dicumenechromium yielded metal chromium platings containing up to 0.05% C. In this case, up to 34% vol % chromium was vapor-deposited on batches of 50 g UO_2 pellets. The platings obtained by the two techniques were of good quality, thick, even, and with a metallic shine. X-ray and chemical analysis revealed no impurities apart from carbon. The coated particles are used to make UO_2–Cr cermets with idealized structures. (auth)

16509 (ORNL–4275) STATUS AND PROGRESS REPORT FOR THORIUM FUEL CYCLE DEVELOPMENT FOR PERIOD ENDING DECEMBER 31, 1966. Wymer, R. G.; Lotts, A. L. (comps.) (Oak Ridge National Lab., Tenn.). Jan. 1969. Contract W-7405-eng-26. 181p. Dep. CFSTI.

A separate abstract was prepared for each of the nine sections comprising the report. (J.C.W.)

For abstracts of individual sections see: 16068, 16069, 16510–16513, 16526, 16547, and 16548.

16510 (ORNL–4275, pp 15-56) SOL-GEL PROCESS DEVELOPMENT. Bond, W. D.; Haas, P. A.

Progress in the development of equipment and process chemistry is reported. The sol-gel process consists of three principal operations. The development of the process for the thorium fuel cycle emphasizes production of microspheres of mixed thoria–urania sols containing greater than 10% UO_2. Flowsheets for laboratory and engineering-scale preparation of urania sols by precipitation–peptization are given. (J.C.W.)

16511 (ORNL–4275, pp 57-87) FUELED-GRAPHITE DEVELOPMENT. Sease, J. D.

The processing equipment for installation in TURF to demonstrate refabrication of HTGR fuel elements is described. The processing steps required in the fabrication of the fueled-graphite elements are outlined. Particle handling techniques are described. Coating methods such as fluidized bed, entrained bed, and a rotary drum are investigated. Particle inspection procedures are described. Techniques for loading the resin-bonded carbon fuel sticks are examined. Results of blending and bonding studies are included. (J.C.W.)

16512 (ORNL–4275, pp 99-120) BULK OXIDE PROCESS DEVELOPMENT. Fitts, R. B.

Sol-gel derived materials were studied for pelletizing because of the relatively low-temperature sintering required to attain moderate densities, the homogeneous nature of the mixtures of fertile and fissile materials, and the suitability of the sol-gel process to the recycle of fuels. Small specimens were fabricated for the determination of mechanical properties and large specimens were fabricated for thermal conductivity studies. Extrusion as a fabrication technique is being developed for sol-gel derived materials of ThO_2, ThO_2–UO_2, UO_2, and PuO_2–UO_2. (J.C.W.)

16513 (ORNL–4275, pp 157-77) DRYING, SINTERING, AND GAS EVOLUTION STUDIES ON SOL-GEL UO_2 MICROSPHERES. Bond, W. D.

Drying and sintering of sol-gel UO_2 microspheres were performed to determine firing conditions that yield products having low carbon content. Firing in an atmosphere containing steam has been successful, but the effects of various atmospheres on the sintering of UO_{2+x} gels were studied to understand carbon removal and UO_2 densification. Isothermal shrinkage of sol-gel UO_2 microspheres has been observed in a hot-stage microscope by sequence photography. Differential thermal analysis was employed to investigate the drying and sintering behavior of sol-gel urania. Sol-gel microspheres of ThO_2 and UO_2 evolved gases when heated. Results are given for urania sol-gel microspheres heated to 1000°C in steam-Ar-4% H_2. (J.C.W.)

16514 (ORNL–4368) STATUS OF EUROPIUM COMPOUNDS FOR REACTIVITY CONTROL IN NUCLEAR REACTORS. Beaver, R. J.; Martin, M. M. (Oak Ridge National Lab., Tenn.). Feb. 1969. Contract W-7405-eng-26. 17p. (CONF-680324–1). Dep. CFSTI.

From Materials Engineering and Sciences Conference and Exposition, Philadelphia, Pa.

Europium is an attractive element for controlling excess reactivity in thermal reactors because of its high thermal neutron absorption cross section of 3980 barns and its inherent resistance to irradiation damage. Compounds of europium, particularly europium sesquioxide (Eu_2O_3), europium titanate ($Eu_2Ti_2O_7$), and europium molybdate ($Eu_{8.3}MoO_{11}$), have been developed for these applications. Procedures are described for preparing these compounds and dispersing them in stainless steel and aluminum. Chemical stability, physical properties, and irradiation behavior of these dispersions are reviewed. (auth)

16515 (ORNL-TM-2417) PERFORMANCE AND STABILITY OF BOROSILICATE GLASSES DURING ROLLING OF STAINLESS STEEL UO_2 FUEL COUPONS. Martin, W. R.; Jones, J. M. (Oak Ridge National Lab., Tenn.). Feb. 1969. Contract W-7405-eng-26. 27p. Dep. CFSTI.

The incorporation of boron in the form of borosilicate glass for burnable poison in UO_2 stainless steel dispersion plates was studied. Fragmentation and stringering of the glasses during rolling varied with both glass composition and rolling temperature. Glass beads rolled much better than irregular particles of the same composition. Boron retention capability of the glass varied also. Corning code 7230 (SiO_2–12.3% B_2O_3) glass beads showed excellent boron retention in plates rolled at 1100°C. The glasses were chemically compatible with both stainless steel and UO_2. (auth)

16516 HIGH-DENSITY UO_2 PELLETS. Haydt, Heliton Motta; Trench de Freitas, Clauer; Capocchi, Jose D. Trani. Metalurgia (Sao Paulo), 24: 139-44(Feb. 1968). (In Portuguese).

Fuel pellets of UO_2, 40 mm. in dia. will be needed for the subcritical reactor RE-SUCO. Experiments were conducted to determine the influence on pellet density of raw material state and sintering conditions at 1400 C in either an Ar or a N_2 atmosphere. In some cases the UO_2 powder was subjected to precompaction and reground before compaction and sintering. Precompaction of the charge caused a relatively slight increase in the density of sintered pellets. The density of pellets sintered in both Ar and N_2 increased with increasing pressure in the normal compaction operation. For a given compaction pressure, density increased with sintering time, with max. density being obtained in about 9 hr. The highest density, in operations where the sintering furnace was arranged for continuous charging, was 9.8 g/cm^3. Densities to 10.2 g/cm^3 were obtained under Ar with batch loading, these higher values being attributed to the increase in the O_2 content of the UO_2. (auth)

16517 THE VACUUM CARBURIZATION OF GROUP IV AND V METALS IN THE PERIODIC SYSTEM OF ELEMENTS. Zhunkovskii, G. L. Metalloved. Term. Obrab. Metal., No. 10, 2-5 (Oct. 1968). (In Russian).

An investigation was made on the carburization of metals in Group IV and V of the periodic system at pressures not above 1×10^{-2} mm Hg. The dependence of the thickness of coatings formed as a function of temperature and time of saturation was determined. Optimum temperatures for saturation of Ti, Zr, Hf, V, Nb, and Ta were found at 1300, 1400, 1100, 1300, 1400, and 1600°C, respectively. The ratio between the thickness of the phases and the width of the area of homogeneity was illustrated by phase diagrams. (tr-auth)

16518 PROCESS FOR MAKING POROUS, LIGHT-WEIGHT ZIRCONIA BODIES. Hare, Weston Andrew (to E. I. du Pont de Nemours and Co.). U. S. Patent 3,421,914. Jan. 14, 1969. Filed Jan. 8, 1968.

A process is described for making a porous refractory material by mixing particles of an acid-soluble refractory material, e.g., magnesia, with particles of zirconia, molding to form a shaped object, firing, and then extracting the acid-soluble refractory material from the fired shape. (AEC)

16519 NUCLEAR FUEL ELEMENTS. Biancheria, Amilcard; Allio, Robert J. (to Westinghouse Electric Corp.). U. S. Patent 3,427,222. Feb. 11, 1969. Filed Oct. 15, 1965.

A nuclear fuel element is described which has a configuration of an elongated tube with closed ends. The tube contains ceramic bodies of sintered fissionable material; and a coating on the bodies which comprises a predetermined amount of an element functioning as a burnable poison. (Offic. Gaz.)

16520 METHOD OF EXTRUDING METALLIC CARBIDES AND IN PARTICULAR URANIUM MONOCARBIDE. Accary, Andre; Magnier, Pierre; Marchal, Michel (to Commissariat a l'Energie Atomique). U. S. Patent 3,428,717. Feb. 18, 1969. Priority date July 17, 1964, France.

The apparatus and method of extrusion of a metal carbide piece comprises extruding this piece in the hot state through a graphite die of high mechanical resistance. (Offic. Gaz.)

16521 METHOD OF PREPARING A FUEL MATERIAL FOR USE IN A NUCLEAR REACTOR. White, G. D.; Handwerk, J. H. (to United States Atomic Energy Commission). U. S. Patent 3,431,329. Mar. 4, 1969.

A method of preparing a fuel material for use in a nuclear reactor is described. The method comprises mixing commercial uranium dioxide, zirconium diboride, and uranium hydride. The amount of uranium hydride added is that amount necessary to react with the hyperstoichiometric oxygen inherently present in commercial uranium dioxide. The mixture is sintered in vacuum as an inert gas to produce fuel materials containing predetermined amounts of boron as burnable poison. (AEC)

16522 USE OF ZONE MELTING AND COLUMN CRYSTALLIZATION FOR PURIFICATION OF THE MOLTEN EUTECTIC KCl-LiCl OF DISSOLVED FISSIONABLE MATERIALS AND FISSION PRODUCT IMPURITIES. v Ammon, Reinhard (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.). Radiochim. Acta, 8: 72-8(1967). (In German). (KFK-728).

Samples of KCl – LiCl eutectic containing small concentrations of UCl_4(UCl_3) or of the fission product chlorides CsCl, $BaCl_2$, $CeCl_3$, $RuCl_3$, and $ZrCl_4$ (0.2 to 0.8 wt % or tracer amounts) were zone melted. Effective distribution coefficients of 0.01 to 0.6 were obtained in the following order: $BaCl_2 < CsCl < UCl_4 = UCl_3 < CeCl_3 < ZrCl_4 < RuCl_3$. Tracer amounts gave the same results as macro concentrations. Column crystallization was applied to the same molten salt mixtures, in order to test the feasibility of using a multistage process which can be adapted to continuous operation for separation problems of molten salts. The depletion factors obtained for total reflux operation are in the region of 0.01 to 0.1 which is equal to only a few theoretical stages of the column. The comparatively poor stage effectivity of the column is attributed to experimental reasons. (auth)

Properties Evaluations

Refer also to abstract 16014.

16523 (DP-MS-68-31) HIGH-TEMPERATURE PROPERTIES OF ACTIVATED CARBON. PART I. DESORPTION OF IODINE. PART II. STANDARD METHOD FOR IGNITION TEMPERATURE MEASUREMENT. Milham, R. C. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). [1968]. Contract AT(07-2)-1. 36p. (CONF-680811-14; SM-110/49). Dep. CFSTI.

From Symposium on Operating and Developmental Experience in the Treatment of Airborne Radioactive Wastes, New York.

The removal of iodine from activated carbon by flowing air was measured at elevated temperatures to evaluate various carbons and to evaluate the effects of variables, such as service, partial regeneration, and temperature, on desorption. The preliminary results are reported. A standard method was developed to measure ignition temperature, to evaluate promising new types of activated carbon, and to evaluate the effects of variables, such as air flow, bed properties, impregnants, and plant service, on ignition temperature. The standard method and results of the evaluation are reported. (auth)

16524 (GAMD-8324) SUMMARY OF THERMAL CONDUCTIVITY TEST RESULTS FOR BEDS OF COATED FUEL PARTICLES. Stevens, D. W. (Gulf General Atomic, Inc., San Diego, Calif.). Oct. 19, 1967. Contract AT(04-3)-633. 18p. Dep. CFSTI.

Test results are given for the thermal conductivity of beds of loose and bonded coated fuel particles. The fuel particles consisted of UC_2, ThC_2, UO_2 and $(Th,U)C_2$ kernels with pyrolytic carbon coatings. Thermal conductivity of small loose particles are lower than that of large loose particles, and conductivity increases with temperature. Beds bonded by the injection molding process have significantly higher conductivities while wet molded bonded beds have lower conductivities. (F.S.)

16525 (N-68-33293) DEVELOPMENT OF CONSTITUTIVE EQUATIONS FOR NUCLEAR GRADE GRAPHITE FOR SPACE APPLICATIONS. 2nd Final Report. Snyder, Robert D. (West Virginia Univ., Morgantown. Engineering Experiment Station). Aug. 1968. 121p. (NASA-CR-96377). CFSTI.

A general constitutive equation for the room temperature mechanical response of nuclear grade graphite is discussed. The stress-strain relation appears to be independent of the rate of loading at short interval impact rates and the response exhibits a pronounced degree of transverse isotropy. The material undergoes permanent plastic deformation even at the lowest stress levels. The scalar theory succeeds in demonstrating rate independence and plasticity while the three dimensional theory incorporates transverse isotropy. The scalar theory provides an excellent correlation with experiment while the three dimensional theory gives a reasonably good conservative correlation. (auth) (STAR)

16526 (ORNL-4275, pp 135-56) ADVANCED SOL-GEL STUDIES. Notz, K. J.; Hamner, R. L.; Bond, W. D.

Thorium dicarbide can be prepared by the reaction $ThO_2 + 4C \rightarrow ThC_2 + 2CO$, which is thermodynamically possible above 1430°C at a carbon monoxide pressure below 1 ton. Dense thoria microspheres are prepared by the sol-gel procedure, and reacted with graphite in a rotating kiln. Another sol-gel procedure utilizes thoria and carbon block combined at the sol stage, converted to microspheres, and caused to react in a suitable furnace. The conversion of UO_2 to UC is discussed. Preparation of porous UO_2, ThO_2, and $ThO_2 - UO_2$ by incorporation and volatilization of chloride or MoO_3 was investigated. Preparation of porous thoria by incorporation of carbon is reported. Properties of carbon-metal oxide sols are discussed. It is noted that urania sols interacted with carbon blocks in a manner analogous to thoria sols. (J.C.W.)

16527 MASS-SPECTROMETRIC DETERMINATION OF COMPOSITION AND VAPOR PRESSURE OF MOLYBDENUM TRIOXIDE. Kazenas, E. K.; Tsvetkov, Yu. B. (Inst. of Metallurgy, Moscow). Zh. Neorg. Khim., 14: 11-13(Jan. 1969). (In Russian).

Saturated vapors of MoO_3 contain molecules of Mo_3O_9, Mo_4O_{12}, and Mo_5O_{15}. In the temperature range from 800 to 1000°K their partial pressures and heats of sublimation were determined and standard changes in isobaric potential and entropies of sublimation were calculated. The rate of sublimation of MoO_3 in the temperature range studied was calculated. (tr-auth)

16528 IMPROVED CEMENTED CARBIDES REDUCE WEAR AND CORROSION. Mater. Eng., 68: No. 2, 30-2(Aug. 1968).

Mechanical properties of cemented carbides used for cutting tools are listed. Tungsten carbide–cobalt is used because of its wettability, high solubility of WC in the binder, and the reversibility of the solution process. Recent WC–Co improvements are increased strength and hardness, ultrafine grain structure, and improved abrasion and wear resistance. Addition of TiC improves cratering resistance and TaC improves hot hardness and ultimate compressive strength. Corrosion resistance is improved by additions of Ni and Cr. Cemented carbides are also used for bearings and seals and grader blades for road maintenance and mining operations. (F.S.)

16529 OPTICAL MATERIALS: GLASSES AND GLASS-CERAMICS. Smith, Gail P. Opt. Spectra, 3: 41-7(Jan.-Feb. 1969).

Information is reviewed on infrared transmitting glasses, fused silica, radiation shielding glasses, photosensitive glasses, and polarizing glasses. (J.R.D.)

16530 UNIQUE OPTICAL CERAMIC. Anderson, Richard C.; Barker, John. Opt. Spectra, 3: 57-60(Jan.-Feb. 1969).

Sintering of high purity yttrium oxide powder doped with thoria produced a new ceramic material with exceptional optical properties and resistance to temperatures in the area of 1900°C. The ceramic holds exciting promise for applications in scientific, industrial and military fields. It has excellent infrared transmission characteristics. Other likely applications are in windows for heat-seeding rockets, windows in high temperature furnaces, and lenses for high temperature cameras and microscopes. The processing technique, which consists of cold pressing directly to optical shapes and then sintering to full density, promises additional economies in both manufacturing and material costs. (auth)

16531 HIGH-TEMPERATURE THERMODYNAMIC PROPERTIES OF URANIUM DICARBIDE. Macleod, A. C. (Morganite Research and Development Ltd., London). J. Inorg. Nucl. Chem., 31: 715-25(Mar. 1969).

The enthalpy of uranium dicarbide was measured from 400 to 1520°K in an adiabatic drop calorimeter. The data are represented by the equation $(H_T - H_{298.15}) = 17.24\ T + 1.3714 \times 10^{-3}\ T^2 + 3.1605 \times 10^5\ T^{-1} - 6322$ with a mean deviation of 0.38%. Molar thermodynamic properties were calculated from 300 to 1800°K and compared with published experimental values. By calculation from existing free energy data and the present enthalpy values, the heat of formation of uranium dicarbide from the solid elements at 298°K was found to be -21.0 ± 0.2 kcal mole^{-1} (auth) (UK)

16532 THE EFFECT OF MICROPOROSITY ON THE ELASTIC MODULUS AND YIELD CURVE OF POLYCRYSTALLINE GRAPHITE. Jenkins, G. M. (University Coll., Swansea, Eng.). J. Nucl. Mater., 29: 322-8(Mar. 1969).

The parameters defining the non-linearity of the stress-strain

curves of graphite under compression are related to the increase in elastic modulus with temperature. Both are shown to be a result of widespread microporosity due to cooling stresses. The analysis is based on a theory of displacements at slit cracks under shear due to the spread of plastic deformation from the tips. Other mechanical properties such as thermal cycling strain, the stress-dependence of thermal creep and the fracture strength are all embraced in the argument. Other materials such as β-eucryptite and cast-iron with similar yield curves and microfissure populations are considered. (auth)

16533 ENTHALPY OF SOLID URANIUM DIOXIDE FROM 2500 °K TO ITS MELTING POINT. Leibowitz, L.; Mishler, L. W.; Chasanov, M. G. (Argonne National Lab., Ill.). J. Nucl. Mater., 29: 356-8(Mar. 1969).

The relative heat content of uranium dioxide was determined between 2500 and 3100°K. The technological importance of this material makes such enthalpy increment data valuable to reactor designers and safety analysts. Data on the relative heat content of solid UO_2 show a rapid increase in heat capacity at the higher temperatures which was not expected from extrapolation of other data. In view of this difference and of the theoretical and technological importance of UO_2, experiments were performed and the resultant data are presented for the relative heat content of solid UO_2 to 3100°K. (auth)

16534 ELECTRICAL PROPERTIES OF (Th,U)C THORIUM CARBIDE–URANIUM CARBIDE SOLID SOLUTIONS. Auskern, A. B.; Aronson, S. (Brookhaven National Lab., Upton, N. Y.). J. Nucl. Mater., 29: 345-8(Mar. 1969).

Thorium carbide–uranium carbide was prepared by reacting UC, Th, and C powder in vacuum at 1750°C for 2 hr. Samples were hot pressed at 1300°C and vacuum annealed at 1800°C to further densify them. Chemical analysis, density, lattice parameters, and the computed valence electron concentration are given. The resistivity, thermal electric effect and the Hall coefficients were determined. (F.S.)

16535 PREPARATION AND THERMAL CONDUCTIVITY OF UO_2 METALLIC CERAMICS OF CERTAIN TEXTURE. Francois, B.; Stora, J. P. (CEN, Grenoble, France). J. Nucl. Mater., 29: 302-14(Mar. 1969). (In French).

A method is proposed for the economic production of materials consisting of granules of ceramic oxides dispersed in a metal matrix. Mixtures of green granules of oxide and metallic powder of controlled particle-size are cold-pressed and sintered. The pressing operation causes a rearrangement of the phases and "metallic veins" are formed normal to the compression direction. This structural anisotropy is responsible, after sintering, for an anisotropy of heat transfer. This process permits the preparation of dispersed oxide fuel elements of high fuel content and with thermal conductivity which is strongly enhanced in the radial direction. This latter property has been confirmed between 300 and 1100°C for specimens in which uranium oxide is combined with tungsten, iron, or nickel: in cermets containing 10 to 30 wt % of metal, the measured thermal conductivity was 50 to 70% of the maximum value estimated for an ideally favorable geometrical distribution of the metallic phase. (auth)

16536 A MATHEMATICAL MODEL FOR CALCULATING STRESSES IN A PYROCARBON- AND SILICON CARBIDE-COATED FUEL PARTICLE. Kaae, J. L. (Gulf General Atomic Inc., San Diego, Calif.). J. Nucl. Mater., 29: 249-66(Mar. 1969).

The analysis employed in calculating the stresses developed during service in a pyrolytic carbon coating on a spherical fuel particle has been extended to consider composite carbide-carbon coatings. In the mathematical model, stresses are considered to result from a pressure buildup inside the coatings due to gaseous fission products; anisotropic dimensional changes induced in the carbon by fast-neutron irradiation; and γ differential thermal expansion, and are considered to be relieved by creep induced in the carbon by fast-neutron irradiation. The silicon carbide coating has been assumed to be rigid since present data seem to indicate that creep and fast-neutron-induced dimensional changes in silicon carbide are negligible under operating conditions. The stresses calculated using the model have been compared with observed fractional failure of coatings during accelerated testing of fuel particles with a number of different dimensions, carbon properties, burnups, and fast-neutron doses. The fraction of failed coatings was high when the calculated stresses were high and was low when the calculated stresses were low. (auth)

16537 THERMAL CONDUCTIVITY OF UO_2–SiO_2 SYSTEMS WITH VARYING UO_2 CONCENTRATION IN THE TEMPERATURE RANGE 100° TO 800°C. Glanz, G. (Institut fuer Atomphysik, Bucharest). J. Nucl. Mater., 29: 329-33(Mar. 1969). (In German).

The thermal conductivity of oxides in the UO_2–SiO_2 system was measured over a limited range of UO_2 concentrations at 100 to 800°C. The results give insight into the conduction mechanism and permit calculation of thermal conductivity in the investigated range of temperatures and compositions. The thermal conductivity of the system is identical with that of pure uranium dioxide for UO_2-contents over 92% and at temperatures above 700°C. This confirms its good applicability as nuclear fuel from this point of view. (auth)

16538 A STUDY OF THE THERMO-KINETICS OF REVERSE DIFFUSION OF CARBON AT THE BOUNDARY BETWEEN THE SOLID AND GASEOUS PHASES OF [IRON–CARBON–YTTRIUM] ALLOYS. Stransky, Karel. Kovove Mater., 6: No. 1, 3-19 (1968). (In Czech.).

The thermo-kinetic characteristics of the reverse diffusion of C in the surface layers of ternary solid solutions annealed at high temperature in vacuum are given. The theoretical analysis is given for a homogeneous solid solution Fe–C–Y, in which C is located interstitially and the added element Y substitutionally. Basic kinetic relationships describing the behavior of these elements on the free surface are derived. The change in the concentration of the added element on the free surface governs diffusion of this element in the direction to or from the surface. Carbon, which is characterized by relatively high mobility, adapts itself to the new distribution of the added element. The mutual sense of all the diffusion fluxes of the added element and C on the phase boundary was determined by the interaction coefficient which determines the mutual sense of the subordinate diffusion fluxes of the two elements. During these processes, C always retards diffusion of the added element. This slowing down is proportional to the product of the concentrations of both elements and the square of the interaction coefficient. These characteristics were used to derive the kinetics of the formation and propagation of concentration waves during reverse diffusion of C. Experiments showed that the theoretically calculated distributions of C and the added element conform to the real distribution, as determined by x-ray spectrographic microanalysis. (F.S.)

Structure and Phase Studies

Refer also to abstract 16514.

16539 (CONF-681031-2) ETA CARBIDES OF MOLYBDENUM–IRON, MOLYBDENUM–COBALT AND MOLYBDENUM–NICKEL. Fraker, A. C. (National Bureau of Standards, Washington, D. C.); Stadelmaier, H. H. (North Carolina State Univ., Raleigh). [1967]. 15p. Dep. CFSTI.

From Fall Meeting of the Metallurgical Society of the AIME, Detroit, Mich.

In the systems Mo–Fe–C, Mo–Co–C, and Mo–Ni–C the phase boundaries of the cubic eta carbides were determined at 1000°C and the variation of the lattice parameter with composition was measured. In the system Mo–Fe–C a single ternary carbide, Mo_3Fe_3C, was observed. In Mo–Co–C and Mo–Ni–C two new eta phases of the type $M_{12}C$ were found: Mo_6Co_6C and Mo_6Ni_6C. At 1000°C they coexist with the M_6C phases $Mo_{3-4}Co_{3-3}C$ and $Mo_{3-4}Ni_{3-2}C$, respectively. Mo_3Co_3C and Mo_4Co_2C are not separate phases but parts of a single M_6C phase region, and the same is true of Mo_3Ni_3C and Mo_4Ni_2C. (auth)

16540 (WAPD-Trans-109) ELECTRON MICROSCOPE OBSERVATIONS OF THIN FILMS OF ZIRCONIUM OXIDE, OBTAINED BY OXIDATION OF ZIRCONIUM. Beranger, G.; Duffaut, F.; De Gelas, B.; Lacombe, P. Translated from J. Nucl. Mater., 19: 290-300(1966). 22p. Dep. CFSTI.

Thin films of zirconium oxide, formed by oxidation of the metal in oxygen for several minutes at temperatures near 600°C, were removed from their metallic substrates and studied in detail by electron and optical metallography. The study covered the epitaxial character of the oxide film, preferential oxidation at grain boundaries, the pronounced influence. (auth)

16541 THE VANADIUM–BORON–NITROGEN SYSTEM. Spear, K. E. (Univ., Muenster, Ger. Univ. of Kansas, Lawrence); Schaefer, H.; Gilles, P. W. Contract AT(11-1)-1140. J. Less-Common Metals, 14: 449-57(1968). (COO-1140-166).

The ternary vanadium–boron–nitrogen phase diagram was established from experiments on the reaction between VN and BN in the presence of nitrogen at a pressure of one atmosphere. No ternary phase was observed in this system. Invariant equilibrium systems of VN–VB–BN, VB–V_3B_4–BN, V_3B_4–V_2B_3–BN, and V_2B_3–VB_2–BN were shown to exist in this constant pressure, three-component system at temperatures of 2010 ± 20, 2180 ± 25,

2290 ± 30, and 2290 ± 30°K, respectively. Ternary solutions were concluded to be slight. (auth)

16542 SOME NEW LANTHANIDE DIBORIDEDICARBIDES. Fishel, Norman A.; Eick, H. A. (Michigan State Univ., East Lansing). J. Inorg. Nucl. Chem., 31: 891-3(Mar. 1969).

Preparation of the diboridedicarbides of cerium, samarium, and thulium is reported, and x-ray powder diffraction analysis was used to establish that these possess the tetragonal symmetry common to the other members of the isostructural LnB_2C_2 series. Attempts to prepare this phase for europium resulted in mixtures of phases. The x-ray diffraction patterns of these mixtures give some evidence for the existence of EuB_2C_2 but the data are not conclusive. The LnB_2C_2 phase was observed for all other lanthanides for which attempts were made to prepare it. (auth) (UK)

16543 PHASE CHANGES IN THE ZrO_2–TiO_2 SYSTEM. Noguchi, Tetsuo; Mizuno, Masao (Government Industrial Research Inst., Nagoya, Japan). Bull. Chem. Soc. Jap., 41: 2895-9(Dec. 1968).

The liquidus curve in the ZrO_2–TiO_2 system previously reported by the present authors was again examined with a heliostat-type solar furnace in order to determine the peritectic point in the ZrO_2-rich side region. Quenched specimens from the melt of the ZrO_2-rich side region were analyzed by the x-ray technique. The cooling curves from the melt suggested the existence of a new phase stable at higher temperatures, and a tentative phase diagram at high temperatures is presented. (auth)

16544 ON THE EXISTENCE OF δ–U_3O_8; A COMMENT ON PAPERS BY KARKHANAVALLA AND GEORGE, AND BY AMIRTHALINGAM. Loopstra, B. O. (Reactor Centrum Nederland, Petten, Netherlands). J. Nucl. Mater., 29: 354-5 (Mar. 1969).

An examination of data on the δ-phase of U_3O_8 showed no crystallographic indications that the δ phase exists. (F.S.)

16545 COMPOSITION AND OXYGEN PRESSURE AT HIGH TEMPERATURE IN NIOBIUM–OXYGEN PHASES IN THE Nb_2O_5–NbO_2 SYSTEM. Abbattista, Fedele (Politecnico, Turin); Chiantaretto, Giampaolo; Tkatchenko, Evghenij Victorovitch. Atti Accad. Sci. Torino. I. Cl. Sci. Fis., Mat. Natur., 102: 865-79(1967-68). (In Italian).

The increase of the reduction isotherm of Nb_2O_5 at 1250°C was determined. The results obtained and the x-ray observations of solid samples prepared by sintering mixtures of Nb_2O_5 and NbO_2 indicate that at 1250°C in the Nb_2O_5–NbO_2 system there are two series of solid solutions contained in the O/Nb atomic ratio intervals of 2.50 to 2.48 and 2.48 to 2.454; the two phases have very restricted compositions corresponding to the formulas $NbO_{2.450}$ and $NbO_{2.432}$. The phase $NbO_{2.48}$, resulting from heating the solids for very long periods, exists in stable conditions only below 1175°C. The decomposition of this phase into $NbO_{2.432}$ + NbO_2 is extremely slow at temperatures of the order of 1200 to 1300°C. The results obtained are discussed and compared with literature results. (tr-auth)

Radiation Effects

Refer also to abstracts 16514 and 17188.

16546 (EURAEC-2072) IRRADIATION OF MIXED UO_2–PuO_2 FUELS IN THE BR-3/PWR REACTOR. Special Report No. 10. Lhost, A.; Bairiot, H. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium). Societe Belge pour l'Industrie Nuclear Brussels). June 1968. Contract 001-64-1-TRUB. 90p. (EUR-4004). Dep. CFSTI.

Work performed under United States–Euratom Joint Research and Development Program.

Plutonium-enriched natural uranium oxide fuel rods were fabricated for insertion in the BR-3 reactor to evaluate the behavior of mixed oxide ceramic fuels in power reactors and define the various characteristics of lattices optimized for plutonium. The UO_2–PuO_2 irradiation in the BR-3/PWR constitutes the first step in the statistical study of rod behavior under normal conditions of use in power reactors. This run is closely linked with the one carried out in the BR-3/VN, with a complete core subassembly enriched with plutonium, and with the one carried out in the BR-3 third core in which a large part of the core consisted of plutonium-containing subassemblies. Irradiation in the BR-3/PWR was the basis of investigation of fabrication method effects. The method consisted of adding plutonium as a fine grain fraction of the powder. Codes were used to estimate parameters of this important stage in the application of plutonium-containing fuels. The large number of checks made at different stages enabled substantial improvement to be made in fuel rod shaping, both as regards the selection of fabrication parameters and as regards finished rod decontamination and study of the importance of hot points. It was confirmed that the power density heterogeneities are about half those of the gamma activity of ^{239}Pu at 384 keV before irradiation. (auth)

16547 (ORNL-4275, pp 88-98) IRRADIATION OF COATED-PARTICLE FUELS. Olsen, A. R.; Coobs, J. H.; Prados, J. W.

The performance of sol-gel-derived UO_2 and $(Th,U)O_2$ microspheres is compared with results of tests on similar coated particles having sintered fuel kernels. Reference comparisons are also made with mathematical model predictions. In an operating high-temperature gas-cooled reactor, fuel composition and irradiation conditions vary with core position. Tabulations for evaluation include fuel variety and kernel size, coated particle variations, fuel irradiation temperature, rate of fission gas release, peak burnup, and the status of the fuel after irradiation. (J.C.W.)

16548 (ORNL-4275, pp 121-34) IRRADIATION OF BULK OXIDE FUELS. Olsen, A. R.; Fitts, R. B.

Radiation effects on sol-gel-derived ThO_2–UO_2, ThO_2, and PuO_2–ThO_2 powder-packed fuel rods are investigated. Low-energy vibratorily compacted sol-gel oxide microspheres are being irradiated. The design criteria for the vibratorily compacted fuel rods for PuO_2–ThO_2 and PuO_2–UO_2 irradiation capsules are given and the characteristics of the sol-gel-derived PuO_2–ThO_2 and PuO_2–UO_2 loaded capsules are tabulated. (J.C.W.)

16549 IONIZATION EXPANSION OF PRESSURE-COMPACTED VITREOUS SILICA. Primak, William; Kampwirth, Robert (Argonne National Lab., Ill.). J. Appl. Phys., 40: 685-90(Feb. 1969).

In vitreous silica compacted by pressure at room temperature, a large proportion of the compaction is gradually released by ionization. This ionization expansion is shown to be a cooperative effect involving both radiation and thermal processes and is therefore termed a radiation-annealing effect. Data are given for soft x-ray radiation annealing at 15 and 100°C, and for radiation annealing after prior thermal annealing for 2 hr at 200°C. The amount of compaction released (dilatation) is proportional to the radiation dose rate, nearly proportional to absolute temperature, rises rapidly from 0 to 3% compaction, and then falls a little with increasing compaction. For vitreous silica compacted at higher temperature, the radiation-annealing rate is much reduced. The initial efficiency of the radiation annealing can be very high, ~10 ionic oxygen volumes for each ionization. The effect seems to be related to transient ionization, which seems capable of releasing compaction over a radius of ~8 ionic oxygen diameters. Accordingly, it is concluded that the infolding of the loops of Si–O tetrahedra in pressure-compacted vitreous silica is locked-in by overlapping strain fields which are unbalanced by transient ionization, and thermal annealing follows. This long-range locking-in may be absent in vitreous silica compacted by other means (e.g., ionization), and then the spectacular release of compaction by ionization does not occur. Other peculiarities of the effect are described and explained. (auth)

16550 ESCAPE BEHAVIOR OF NON-GASEOUS FISSION PRODUCTS RECOILED INTO GRAPHITE. Iwamoto, K. (Atomic Energy Research Inst., Ibaraki, Japan). J. Nucl. Mater., 29: 285-301(Mar. 1969).

The escape behavior of non-gaseous fission products recoiled into graphite was studied. Annealing was done isothermally at 200 to 1450°C for 10 min to 24 hr. The fission products within the graphite crystal and on its surface were determined by leaching the annealed graphite sample with nitric acid. The fractions of fission products remaining within the crystal, existing on the surface, and lost during the annealing were obtained for ^{131}I, ^{140}Ba, ^{89}Sr, ^{137}Cs, ^{141}Ce, ^{103}Ru, ^{95}Zr–^{95}Nb, and for the gross fission products as a function of temperature and time of annealing. It was postulated that the fission products formed surface compounds immediately after they reached the surface of the graphite crystal and these compounds desorbed. The mathematical expressions for the release, diffusion and desorption processes are presented. The trapping state of each fission product in the graphite crystal was represented by an initial activation energy spectrum, and special defects having the activation energies for release of 1.3 ± 0.1, 2.0 ± 0.1, and 2.9 ± 0.1 eV/atom were found to be effective in trapping fission products. The diffusion resistance for released fission products could be regarded as negligible in the slow step of migration in the graphite. The desorption behavior was satisfactorily explained by the model that fission products desorbed from a heterogeneous surface. (auth)

16551 PROPERTIES OF IRRADIATED SILICA FIBRE REINFORCED ALUMINUM. Piggott, M. R.; Hunton, A. E. (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Nucl. Mater., 29: 334-44(Mar. 1969).

Samples of silica-fiber-reinforced aluminum have been irradiated at 35, 300, and 410°C to determine their utility in the reactor environment. In addition, the constituents were irradiated separately. Tests on the composites indicate that they may be used at high stresses at temperatures only up to about 300°C, are not degraded by irradiation up to a dose of $3-5 \times 10^{19}$ $n_f v t$ at this temperature, and gain strength on being irradiated at about 35°C. Tests on the constituents indicate that silica fibers lose strength as a result of irradiation, but not to an extent likely to affect the composite except over a long period ($\gg$1 year at fluxes in the region of 2×10^{12} $n_f v$), and that the reason for the increase in strength of the composite when irradiated at about 35°C is the increase in flow stress of the aluminum produced by the irradiation. The effect on composites of changes in the flow stress of the matrix material is discussed, and it is shown that in general the higher the flow stress of the matrix the stronger the composite will be, so long as the material does not become notch brittle. (auth)

Plastics and Other Materials

Refer also to abstracts 16002 and 16057.

16552 (BNL-50134) CONCRETE-POLYMER MATERIALS. First Topical Report. Steinberg, M.; Kukacka, L. E.; Colombo, P.; Kelsch, J. J.; Manowitz, B. (Brookhaven National Lab., Upton, N. Y.); Dikeou, J. T.; Backstrom, J. E.; Rubenstein, S. (Bureau of Reclamation, Denver, Colo.). Dec. 1968. 83p. (USBR GEN. REP.-41). Dep. CFSTI.

Activities are reported in a program established between the U. S. Bureau of Reclamation and BNL to investigate and develop concrete-polymer composites as improved building materials. Information is presented concerning concrete formation, polymer formation, concrete-polymer preparation, measurement of composite specimens, basic research, and applications development. (J.R.D.)

16553 STRESS CORROSION CRACKING: AN IMPORTANT CRITERION IN THE USE OF PLASTICS IN PLANT CONSTRUCTION. Czeija, Karl. Werkst. Korros., 19: 316-20(Apr. 1968). (In German).

Stress-corrosion cracking of plastics depends on the molecular weight, density, melt index, chain branching, and crystallinity of the material. The suitability of plastics such as PVC, polyamides, polycarbonates, and especially polypropylene sheet and tube for chemical plant construction is discussed, and the past experience is summarized. The material should be stress-relieved before use, and the finished plant tempered by heating. Stress-corrosion can also be reduced by radiation, and by the use of fillers or glass fibre reinforcement. (L.C.L.)

16554 THERMAL DIFFUSION AT MODERATE PRESSURES IN He–CO_2 MIXTURES. Velds, C. A.; Los, J.; De Vries, A. E. (FOM-Instituut voor Atoom- en Molecuulfysica, Amsterdam). Physica, 35: 417-40(1967).

Thermal diffusion factors were measured for the systems He–$^{14}CO_2$ and He–$^{12}CO_2$ in the temperature range 301 to 624°K and up to 141 atm pressure in a two-bulb apparatus. The analyses were done with ionization chambers and a mass spectrometer. Besides the mixture with trace concentration CO_2 also He–^{85}Kr was measured for which no pressure effect was found. For the mixtures with higher CO_2 concentrations, however, a large increase of α with pressure was obtained, especially at the lowest temperature. The results were compared with present theory based on the thermodynamics of irreversible processes. The theory seems to be unsatisfactory for trace concentrations but can predict qualitatively the experiments with higher CO_2 concentrations. A non-ideality theory given by Becker was extended by means of a thermodynamic treatment to include all interactions. The theoretical dependence on pressure for both theories, although qualitatively correct, is larger than the experimental, especially in the lower pressure range. In the He–CO_2 mixture dimerisation is of minor influence on the pressure dependence of α. (auth)

PHYSICS (GENERAL)

Astrophysics and Cosmology

Refer also to abstract 16652.

16555 (N-68-33525) THE EFFECT OF BULK MOTION ON THE SYNCHROTRON RADIATION RATE. Noerdlinger, Peter D. (State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy). July 1968. 8p. (NASA-CR-96471). CFSTI.

Calculating the power emitted in the c.m. system and then transforming this result into the lab. system is considered the surest way to obtain the proper synchrotron radiation rate for an ensemble of relativistic particles in bulk or mean motion. Scheuer asserts that the apparent luminosity of any synchrotron-radiating source can be found by multiplying the power per electron by the mean number of electrons in the source with appropriate pitch angle to radiate toward the observer. This rule is considered valid for steady sources that do not move, but two examples are cited for which it fails. One case is that of an isotropic distribution of electrons in a tangled magnetic field, the whole in motion; the second is a model for a quasi-stellar source. (STAR)

Cosmic Ray Exposure Ages

16556 (N-68-34058) RARE EARTH ABUNDANCES IN METEORITIC CHONDRULES. Schmitt, R. A.; Smith, R. H.; Olehy, D. A. (Oregon State Univ., Corvallis. Dept. of Chemistry). [1967]. Contract NASw-943. 17p. (NASA-CR-84733). CFSTI.

Summary data are given on an investigation in which radiochemical neutron activation analysis was used to determine the elemental abundance distribution of the 14 rare earth elements and yttrium in chondrules from Mokoia, Chainpur, Forest City, and Richardton. Tabulated data are included on absolute abundances, and a comparison is made of the normalized abundances of the 14 REE and Y in 20 chondritic meteorites. The ratios of the respective normalized values in the chondrules to average normalized values in 20n chondrites were plotted versus the ionic radii of the REE. (STAR)

16557 EVOLUTION OF THE LEAD ISOTOPE COMPOSITION OF THE EARTH'S CRUST AND OF IRON METEORITES. Naydenov, B. M.; Cherdyntsev, V. V. (Mineral Raw Materials Inst., Moscow. Geological Inst., Moscow). Geochem. Int. (Engl. Transl.), 4: 1132-6(1967).

Translated from Geokhimiya, No. 12, 1453-7(1967).

More than 1500 determinations of the isotopic composition of ore leads were subjected to least-squares analysis using parabolic and hyperbolic regression curves. The change with time of the ratio of radiogenic lead isotopes to ^{206}Pb is shown. An early supply of ^{238}U to the Earth's crust is required to explain the data. (auth)

Stars

Refer also to abstracts 16611, 16683, and 16996.

16558 (MNC-3783-1) ON THE PRODUCTION OF NUCLIDES WITH A > 250 IN STELLAR NUCLEOSYNTHESIS. Viola, V. E. Jr. (Maryland Univ., College Park. Dept. of Chemistry). Nov. 27, 1968. Contract AT(40-1)-3783. 30p. Dep. CFSTI.

An attempt is made to explore the extent to which nuclides with A > 250 may have been formed during stellar nucleosynthesis and the subsequent fate of such species during cosmological time. Two recent results concerning the nuclear behavior of the heaviest elements bear directly on these questions; i.e., (1) the measured yields of multiple neutron-capture products in thermonuclear explosions, and (2) the apparent fission instability of N = 158 isotones. In addition, these considerations are relevant to the questions of U-Th abundance in nature and the possible role of spontaneous fission decay in Type I supernovae, which are also discussed. As a basis for discussion, the multiple neutron capture model (r-process) of Seeger, Fowler, and Clayton was chosen. However, the results can in general be applied to any nucleosynthesis process which occurs on a time scale longer than milliseconds. (W.D.M.)

16559 (N-68-31168) RANDOM INDEPENDENT SPLITTING MODEL FOR THE MASS SPECTRUM OF PROTOSTARS AND INTERSTELLAR CLOUDS. Marcus, A. H. (Bellcomm, Inc., Washington, D. C.). June 7, 1968. Contract NASw-417. 35p. (NASA-CR-95938; TR-68-340-2). CFSTI.

It is often assumed that stars are formed when a large initial cloud splits up into smaller fragments, each of which may in turn split into smaller pieces, and so on. This continues until the final stage before the cloud condenses into a visible star, at which stage the cloud fragment may be called a protostar. A simple mathematical model is presented for the expected number density (i.e., "mass spectrum") of cloud fragments which does not require detailed knowledge of the physics of the fragmentation process, but uses merely some simple and plausible phenomenological hypotheses. The present state of empirical evidence about the initial mass spectrum of protostars and interstellar clouds is first reviewed. A mathematical model proposed by Filippov (1960) for the mass spectrum of objects formed by the repeated random independent splitting of an initial object is described and expanded upon. (auth) (STAR)

16560 ASTROPHYSICAL DETERMINATION OF f-VALUES FOR Ti II, Cr II, Fe II. Little, Stephen J.; Ross, John E.; Aller, Lawrence H. (Univ. of California, Los Angeles). pp 593-610 of Beam-Foil Spectroscopy. Vol. II. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.2).

Factors that adversely affect the determination of relative f values from a stellar curve of growth are listed, and means of minimizing these effects are considered. Advantages of empirical astrophysical line strengths are also listed. Numerical procedures used to obtain f values for Ti II, Cr II, and Fe II from spectra of several stars are described briefly, and results are tabulated. These values are then used to construct a curve of growth for HD 168733, a star not included in the original analysis, and f values for HD 168733 are compared with laboratory results. (A.G.W.)

16561 ANALYSIS OF STELLAR SPECTRA AND THE DETERMINATION OF f-VALUES. Aller, Lawrence H. (Univ. of California, Los Angeles). pp 575-92 of Beam-Foil Spectroscopy. Vol. II. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.2).

The determination of f values from stellar spectroscopic data is reviewed. The curve-of-growth method is emphasized. Astrophysical f values obtained by various investigators are compared with laboratory values, in tables, for Mn I, Mn II, Sc II, and Zr II. Advantages and limitations of astrophysical methods are considered. (A.G.W.)

16562 EXAMPLES OF ASTRONOMICAL NEEDS FOR ATOMIC SPECTRA. Swings, Pol; Swings, Jean Pierre (Astrophysical Inst., Liege). pp 525-38 of Beam-Foil Spectroscopy. Vol. II. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.2).

Examples given of studies of atomic spectra needed by astronomists include the following: (1) work on N IV in connection with puzzles in Wolf-Rayet stars; (2) work on C I to IV, N I to V, O I to IV, and Si I to IV in connection with unexplained emissions from O stars; (3) work on N I, C I, and S I in connection with forbidden lines that may appear in absorption in the sun or in stars of types F to K. General improvement in accuracy of wavelength measurements is also desirable. (A.G.W.)

16563 SPECTROPHOTOMETRY OF A SUPER-DENSE PLANETARY NEBULA M3-27. Kohoutek, L. (Astronomical Inst., Prague). Bull. Astron. Inst. Czech., 19: 371-80 (1968).

The planetary nebula M3-27 (43 + 11°1) was found an objective prism spectrum within the interval λλ 3600 to 6600 Å as a very dense and young object of intermediate excitation class 6p. The visual interstellar extinction $A_V = 1.8$ mag. and the distance r = 1.44 kpc of the nebula were determined. If the nebula is optically thick in the H I Lyman continuum (hypothesis A), which seems most reliable, the following parameters for the exciting star were deduced: $T_* = 103000°K$, $M_{bol,*} = -0.6^m$, $M_{V,*} = +6.4^m$, $R_* = 0.04\ R_\odot$. Then the faint continuum observable at λλ 3850 to 6200 Å might be explained by assuming either a high electron temperature of the nebula ($T_e \sim 50000°K$, and hence: $N_e \simeq 10^{6.0}\ cm^{-3}$, the angular diameter $\varphi \simeq 0.5''$, the linear radius $R_n \simeq 0.002$ pc, $M_n \simeq 7 \times 10^{-4}\ M_\odot$), or the presence of the relatively cool F0-F5 III star; in this case the nebula could have a common electron temperature ($T_e \sim 14000$ to $20000°K$, and hence: $N_e \simeq 10^{6.7}$ to $10^{6.4}\ cm^{-3}$, $\varphi \simeq 0.08$ to $0.17''$, $R_n \simeq 0.0003$ to 0.0006 pc, $M_n \simeq 1.3$ to $5.4 \times 10^{-5}\ M_\odot$). For the optically thin nebula one would obtain

a lower temperature, a larger luminosity and a larger radius of the exciting star (hypothesis B), and the extraordinarily low mass of the whole nebula $M_n \lesssim 5 \times 10^{-5} M_\odot$. (auth)

16564 ANALYSIS OF THE CEPHEID VARIABLE RT AURIGAE. Bappu, M. K. V.; Raghavan, Nirupama (Astrophysical Observatory, Kodaikanal, India). Mon. Notic. Roy. Astron. Soc., 142: 295-316(1969).

High-dispersion spectra of the cepheid variable RT Aurigae were used for an analysis of the parameters of the stellar atmosphere over a cycle of pulsation. Eighteen of these spectra were utilized for a study of the radial velocities. The displacement curve derived from the velocities was utilized with the light and colour curves of Eggen, Gascoigne, & Burr (1957) to furnish by the application of Wesselink's (1966) method a value of $R/R_\odot$ = 33.7. A differential curve of growth analysis relative to the Sun was carried out at eleven phases to evaluate the variation of the atmospheric parameters. The range in θ_{exc} is from 0.94 to 1.07. The variation of $\rho\kappa$ is by a factor of ten over the cycle. A second hump in this curve at phase 0.68 P is perhaps a result of the sudden onset of a pulse of compression. Mean abundances relative to [Fe] were derived for 21 elements. A general deficiency in s-process elements is seen in comparison with those formed by the e-process. (auth) (UK)

16565 EXCITATION OF FORBIDDEN LINES IN GASEOUS NEBULAE. I. FORMULATION AND CALCULATIONS FOR $2p^q$ IONS. Saraph, Hennelore E.; Seaton, M. J.; Shemming, Jillian (University Coll., London). Phil. Trans. Roy. Soc. London, Ser. A, 264: 77-105(Feb. 20, 1969).

A formulation is given for electron collisions with ions in configurations $1s^22s^22p^q$ and $1s^22s^22p^63s^23p^q$. The main approximation is neglect of coupling to other configurations. Hartree–Fock functions are used for the ion states and the complete wave functions are expressed as sums of vector-coupled antisymmetrized products of ion functions and orbitals for the colliding electron. Variational principles are used to obtain coupled integro–differential equations for the radial functions for the colliding electron, and to correct results obtained from approximate solutions of these equations. All algebraic reductions are carried out without the introduction of subsidiary approximations, and conservation and reciprocity theorems are therefore satisfied exactly. Expressions are tabulated for all algebraic coefficients. Numerical calculations are made in two approximations: in the exact resonance approximation, used only for p waves, the wave functions are calculated with quadrupole interactions neglected; and in the distorted wave approximation the wave functions are calculated from static central potentials. Variational corrections are calculated and are found to be reasonably small. It is concluded that the final corrected results should agree closely with results which would be obtained from exact solutions of the coupled equations. Collision strengths are calculated for all inelastic collisions in configurations $1s^22s^22p^q$, q = 1 to 5, for at least three different energies, and for values of the residual charge z = 1, 2, 3, 4, 5, and the limit of $z \to \infty$. Results may be interpolated for all members of the isoelectronic sequences. Results for energies such that some channels are open and others closed are obtained by means of extrapolation techniques. (auth) (UK)

16566 PRINCIPLES OF STELLAR STRUCTURE. VOLUME 2. APPLICATIONS TO STARS. Cox, John P. New York, Gordon and Breach, Science Publishers, Inc., 1968. 780p. $75.00 (Vols. 1 and 2).

Volume II of the two-volume series, Principles of Stellar Structure, builds on the background in the basic physics of stellar interiors developed in Vol. I of the series. It applies this background to practical problems encountered in the study of stars and stellar interiors. It is a direct continuation of Vol. I. (W.D.M.)

16567 PRINCIPLES OF STELLAR STRUCTURE. VOLUME 1. PHYSICAL PRINCIPLES. Cox, John P. New York, Gordon and Breach, Science Publishers, Inc., 1968. 588p. $75.00 (Vols. 1 and 2).

Volume I treats the basic physics that underlies present theories of stellar interiors. The book will be useful as a reference work for research workers studying stellar structure, as well as for first-year graduate students and advanced undergraduates with strong backgrounds in the physical sciences. (W.D.M.)

16568 SPECTRA OF THE IRREGULAR VARIABLE V 348 SAGITTARII IN THE VICINITY OF MAXIMUM LIGHT. I. DESCRIPTION OF SPECTRA AND IDENTIFICATIONS. Houziaux, L. (Univ., Liege). Bull. Astron. Inst. Czech., 19: 265-74 (1968). (In French).

The Pd 3862 and 3867 spectra of V 348 Sgr., taken while the star was at the light maximum (V = 11.8), were analyzed. The equivalent lengths of numerous emission and absorption components were measured. The results of the measurements are tabulated. The C(II), He(I), O(II), N(II), H(I), and other element spectra are described and the transitions observed are tabulated. (J.S.R.)

16569 THE ENERGY OF A ROTATING STAR AND ITS DEPENDENCE ON THE ANGULAR-VELOCITY DISTRIBUTION. Vandakurov, Yu. V. (Ioffee Physicotechnical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 647-54(Jan.-Feb. 1969).

Translated from Astron. Zh., 45: 813-22(July-Aug. 1968).

A discussion is given of the problem of determining the angular-velocity distribution satisfying the condition of a minimum in the total energy of a star having a prescribed angular momentum. A slowly rotating star with a radiative core, a convective envelope, and a luminosity $L < L_\odot$ is investigated. A numerical integration of the equations of equilibrium for a series of models with an angular velocity depending only on the distance to the center indicates that the energy decreases as the fraction of the angular momentum contained in the central part of the core increases. Models exist whose energy is greater in a stationary state than in a rotating state (for identical conditions at the surface). Since the configurations discussed here have a very high concentration of angular momentum toward the center, the state with minimum energy would be expected to be unstable against excitation of turbulent meridional mass motions. A model is considered with a magnetic field that accelerates the rotation of the central part of the core until an instability sets in, returning the system to some initial state. The model is characterized by enhanced flattening and has a surface layer in differential rotation with minimum angular velocity at the poles. It is suggested that a magnetic field of this type may exist inside the Sun. (auth)

16570 ECLIPSING VARIABLES NEAR THE MAIN SEQUENCE. Popov, M. V. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 640-6(Jan.-Feb. 1969).

Translated from Astron. Zh., 45: 804-12(July-Aug. 1968).

Absolute dimensions for 34 eclipsing variable systems having both components near the main sequence were computed from published data. An analysis of the location in the H–R diagram of stars belonging to systems with reliably determined absolute dimensions indicates that such stars fall along lines of equal age. A comparison of the mass–luminosity, mass-spectrum, and other relations derived from eclipsing systems with the theoretical relations for homogeneous model stars demonstrates that the observational data and theoretical calculations are in good agreement. (auth)

16571 THE DISPERSION IN THE TWO-COLOR DIAGRAMS OF OPEN STAR CLUSTERS. Starikova, G. A. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 632-9(Jan.-Feb. 1969).

Translated from Astron. Zh., 45: 795-803(July-Aug. 1968).

An analysis of photoelectric and photographic observations in the UBV system by various authors of stars in open clusters indicates that the dispersion in the two-color diagrams of open clusters depends both on the color excess of the cluster stars and on the direction in the Galaxy — that is (just as with the absorption of light) on the structure of the absorbing material and the physical properties of the Galaxy in a given direction. The pattern obtained for the variation of the dispersion with color excess and galactic longitude suggests a hypothesis for the structure of the absorbing material in the Galaxy's spiral arm that passes near the Sun. (auth)

16572 UNITY IN THE STRUCTURE OF STAR CLUSTERS. Kholopov, P. N. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 625-31(Jan.-Feb. 1969).

Translated from Astron. Zh., 45: 786-94(July-Aug. 1968).

Some results are summarized from a series of papers reporting analysis of star counts in the extended neighborhoods of star clusters. Most of these investigations were carried out by the author in collaboration with N. M. Artyukhina. Every star cluster comprises at least two main regions, a nucleus and a corona. The ratio of the corona radius R_c to the nucleus radius r_n correlates with the cluster mass, ranging from 2.5 to 3 for clusters with a small number of members to 10 for more populous clusters. The values of r_n and R_c increase with the number of cluster members. The coronal regions of clusters are shown to be dynamically stable in the field of the Galaxy's tidal forces; they are formed by regular cluster members, not by stars that are escaping from the clusters. Despite the gradual passage of stars from the nuclear region into the coronal region, a process that undoubtedly does occur, the corona apparently is not merely generated by the nucleus but develops together with the nucleus when a diffuse cloud containing a central condensation is transformed into a star cluster. Many comparatively compact O associations actually are not systems of positive energy in their initial stage of expansion, but are ordinary, dynamically stable, young star clusters. (auth)

16573 K-LINE PHOTOMETRY OF A STARS. Henry, Richard C. (Princeton Univ., N. J. Kitt Peak National Observatory, Tucson, Ariz.). Astrophys. J., 18: Suppl. Ser. No. 156, 47-72 (Mar. 1969).

A narrow-band spectrometer, compensated for seeing and transparency variations, has been constructed and used to measure the strength of the calcium K-line in 146 A-type stars. The K-line strength was found to be a reddening-independent temperature parameter in A stars, with an rms error of ±0.012 mag in the derived b−y color. Abnormal stars usually could be excluded using four-color and Hβ photometry. Additional scatter present in the K-line strength was found to be due to calcium-abundance variations, and a correlation was obtained with deviations from the normal value of Strömgren's [m_1] metal-abundance index. Line-strength calculations showed that the relative abundance of calcium in low-velocity, main-sequence A stars varies by a factor 2. A systematic overabundance of about a factor of 2 for these stars, relative to the Sun, is suggested by the calculations. A substantial fraction of the Am stars observed was found, surprisingly, to have normal K-line strengths. Several new low-velocity, low-metal-abundance stars and K-line variables were discovered. (auth)

16574 SUPERNOVAE. Shklovskii, I. S. Interscience Monographs and Texts in Physics and Astronomy. Volume XXI. New York, John Wiley and Sons, Inc., 1968. 451p. $20.00.

Translated from the Original Manuscript by Literaturprojekt, Innsbruck, Austria.

General information on supernovae is reviewed in terms of photometrical and statistical investigations, spectra and their interpretation, galactic supernovae, and the sling effect. Optical characteristics, rf emission, flux and intensity, variations, shock waves, and magnetic field effects of remnants of Type II supernovae are discussed. The Crab Nebula is considered in detail. Other problems and theoretical questions taken up include origin of cosmic radiation, effects of supernovae outburst in the solar vicinity, and causes of supernovae explosions. (W.D.M.)

16575 A RECALIBRATION OF THE ABSOLUTE MAGNITUDES OF STARS CONSISTENT WITH THE PHOTOMETRIC DISTANCE MODULI OF CLUSTERS. Fitzgerald, M. Pim (Case Western Reserve Univ., Cleveland). Publ. Astron. Soc. Pac., 81: No. 478, 71-3(Feb. 1969).

Seventy-four clusters were used for this calibration, 65 of which were in the list of Hoag and Applequist (1965). The additional data came from papers by Johnson (1953) Morgan and Hiltner (1965), Wildeg (1963), and Svolopoulos (1961, 1962). Stars in the Hyades and Pleiades clusters given in the Catalogue of Bright Stars (Hoffleit 1964) were also used. These sources provided 484 stars suitable for calibration purposes, of which 311 were in the range O to AO. The procedure followed was that used by Weaver and Ebert (1964), and the cluster moduli adopted were those given in the above papers. (W.D.M.)

16576 ATMOSPHERES OF ROTATING STARS. Smak, Jozef. Postepy Astron., 16: 319-41(Dec. 1968). (In Polish).

A review of recent papers concerning the influence of stellar rotation on the basic photometric and spectroscopic parameters of the stars is given. (auth)

16577 PHOTOELECTRIC ELEMENTS OF THE ECLIPSING BINARY TX LEO. Srivastava, J. B.; Kandpal, C. D. (Uttar Pradesh State Observatory, Naini Tal, India). Bull. Astron. Inst. Czech., 19: 381-9; 390a(1968).

Photometric elements were derived from photoelectric observations in two colors. Combined with spectroscopic elements by Chamberlin and McNamara (1957), they yield the absolute elements. The system is found to consist of two stars on the main sequence. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

16578 (N-68-34690) X-RAY TEST FOR SUPERDENSE STARS. Boldt, Elihu (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Sept. 1968. 5p. (NASA-TM-X-63331; X-611-68-348). CFSTI.

As strong thermal x-ray emission from a small source (≈10^6 cm) is a signature to be expected from a superdense star, it is pointed out that the superdense star hypothesis for a thermal x-ray source may be tested by measuring the statistical fluctuations in the observed x-ray photon count. As an example, this is shown to be a practical test for the x-ray star Sco X-1. (auth) (STAR)

16579 LINE IDENTIFICATIONS IN QUASI-STELLAR OBJECTS. Lynds, C. R. (Kitt Peak National Observatory, Tucson, Ariz.). pp 539-74 of Beam-Foil Spectroscopy. Vol. II. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.2).

General characteristics of the spectra of quasi-stellar objects and difficulties of line identification are reviewed. A table lists various types of transitions established or suspected in the spectra of quasi-stellar objects, arranged according to the type of species in which they occur. Spectrograms of a representative sample of objects are shown and discussed. (A.G.W.)

16580 THE LINEAR POLARIZATION OF RADIO SOURCES BETWEEN 11- AND 20-CM WAVELENGTH. I. OBSERVATIONS. Gardner, F. F.; Morris, D.; Whiteoak, J. B. (Commonwealth Scientific and Industrial Research Organization, Epping, New South Wales). Aust. J. Phys. 22: 79-106(Feb. 1969).

Observations are presented of the linear polarization of 366 sources observed with the Parkes 210 ft telescope at frequencies of 2650, 1660, and 1410 MHz. Parameters derived from the results, namely rotation measure, intrinsic polarization angle, and depolarization, are tabulated together with other pertinent physical properties. The source list includes 64 quasars, 119 radio or normal spiral galaxies, and 31 galactic objects; the remainder are unidentified objects or doubtful identifications. (auth)

16581 THE LINEAR POLARIZATION OF RADIO SOURCES BETWEEN 11- AND 20-CM WAVELENGTH. II. POLARIZATION AND RELATED PROPERTIES OF EXTRAGALACTIC SOURCES. Gardner, F. F.; Whiteoak, J. B. (Commonwealth Scientific and Industrial Research Organization, Epping, New South Wales). Aust. J. Phys., 22: 107-19(Feb. 1969).

The polarization properties of quasars, radio galaxies, and unidentified objects at 11 and 20 cm wavelength are discussed and compared with other source characteristics. For some quasars, scintillation and spectral data are in accord with current ideas that the sources comprise a small component radiating only at high frequencies and a larger component with a radiation spectrum similar to radio galaxies. The polarization is associated with this second component. For radio galaxies, the lower polarization of scintillators and a decrease of luminosity with increasing polarization suggest that sources of high brightness have low polarization. In spectral and polarization characteristics, the unidentified sources are similar to radio galaxies. Source evolution is discussed; the results suggest that quasars and radio galaxies evolve separately rather than represent different stages of a single evolutionary sequence. (auth)

16582 A LOW-LATITUDE SURVEY FROM l^{II} = 27° TO 38° AT 1410 AND 2650 MHz. Beard, M.; Kerr, F. J. (Commonwealth Scientific and Industrial Research Organization, Epping, New South Wales). Aust. J. Phys., 22: 121-6(Feb. 1969).

This paper presents contour maps of a region of the Milky Way at 1410 and 2650 MHz. A list of sources with values of flux densities and peak temperatures is given. (auth)

16583 GALACTIC H II AND THE DISPERSION MEASURES OF THE PULSARS. Davidson, Kris; Terzian, Yervant (Cornell Univ., Ithaca, N. Y.). Nature (London), 221: 729-32(Feb. 22, 1969).

It is stated that for pulsars at distances of several kpc, the "dispersion measure" $\int n_e ds$, may depend primarily on the H II regions in the line of sight. The importance of hydrogen ionized by early-type stars can be estimated. (auth) (UK)

16584 LUNAR OCCULTATIONS OF RADIO SOURCES AT 81.5 MHz. Collins, R. A.; Scott, P. F. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc., 142: 317-32(1969).

An aerial for the observation of lunar occultations at 81.5 MHz is described and details of the experimental procedure and data reduction given. The results obtained from occultations of six radio sources are presented and compared with measurements made at higher frequencies. (auth) (UK)

16585 DISTANCE ESTIMATES FOR PULSARS. Grewing, M.; Mebold, U.; Rohlfs, K. (Max Planck Inst. for Radioastronomy, Bonn. Univ., Bonn). Nature (London), 221: 751-3(Feb. 22, 1969).

The distance estimates for pulsars based on an interstellar electron density $\langle n_e \rangle = 0.1\ cm^{-3}$ have recently been questioned. In this paper the problem of distance estimates is discussed in a general way. It is found that in order to decide whether or not these objects are inside the galactic disk, their temperature has to be known rather accurately. Crude temperature estimates were obtained from 21-cm emission profiles, and results are tabulated. A conclusion reached is that the majority of these objects can neither be confined to the vicinity of the Sun nor be

at distances very much larger than the path length through the galactic disk. Data are given for the location of known pulsars with respect to the galactic disk and for derived distance estimates for 14 pulsars. For each pulsar two values (maximum and minimum) were assumed for the electron temperature, which should bracket the true value, and the derived distance estimates should bracket the true distance. The values involve the path length in the galactic disk, with application of a scaling factor. An independent estimate of distance is calculated from low frequency absorption data. The distance estimates are in general agreement, although the estimates based on absorption data are systematically larger. The inferred distance of pulsars is strongly dependent on the temperature assumed for the interstellar medium in the direction of the object. It is considered that a single value for the electron temperature of the interstellar medium is not enough. The effect of ionisation of the interstellar medium by subcosmic rays is considered. (UK)

16586 POLARIZATION OF RADIO PULSES FROM PULSAR CP 0328. Clark, R. R.; Smith, F. G. (Univ. of Manchester, Eng.). Nature (London), 221: 724-6(Feb. 22, 1969).

It is stated that pulse-by-pulse observations of CP 0328 have revealed very high degrees of polarization. (auth) (UK)

16587 HIGH-RESOLUTION OBSERVATIONS OF BRIGHT EMISSION NEBULAE AT 408 MHz. Shaver, P. A. (Univ. of Sydney). Mon. Notic. Roy. Astron. Soc., 142: 273-87(1969).

Several bright emission nebulae were observed at 408 MHz with the 2.8′ pencil beam of the new Mills Cross radio telescope. The separate components in each nebula were resolved and their electron temperatures determined—these are generally consistent with the nα radio recombination line values, and considerably less than 10,000°K. Evidence is presented which indicates the presence of temperature variations in the nebulae. The spectral properties of the individual components were studied, and a large nonthermal ring was found in W 51. (auth) (UK)

16588 CONVERSION OF PLASMA WAVES INTO ELECTROMAGNETIC WAVES IN A STRONG MAGNETIC FIELD. Tsytovich, V. N.; Kaplan, S. A. (Lebedev Inst. of Physics, Moscow. Gorky State Univ., USSR). Sov. Astron. AJ (Engl. Transl.), 12: 618-24(Jan.-Feb. 1969).

Translated from Astron. Zh., 45: 777-85(July-Aug. 1968).

The conversion coefficients of plasma waves into electromagnetic waves in a plasma with a strong magnetic field ($\omega_{He} \gg \omega_{0e}$) are found. The nonlinear scattering of plasma waves by thermal and superthermal ions, and nonlinear coalescence of plasma waves are considered. It is shown that stimulated emission leads to an effective increase of the radioactive fields at frequencies $\omega_{He} \sim eH/m_e c$. Since the refractive index here is near to unity, for $\omega_{He} \gg \omega_{0e}$ the maser effect is possible in a wider interval of frequencies than in the case of $\omega_{He} \ll \omega_{0e}$. The energy of plasma waves at frequencies $\sim\omega_{He}$, generated by beam instability, is mo rapidly transferred into electromagnetic energy than it is redistributed along the spectra of wave numbers of the plasma turbulence. The possibility of application of these results to the analysis of radio emission of Jupiter and other objects is discussed. (auth)

16589 FLUX DENSITIES AND SPECTRAL INDICES FOR THE SOURCES IN THE 3C AND 3CR CATALOGS AT 86-MHz FREQUENCY. Artyukh, V. S.; Vitkevich, V. V.; Dagkesamanskii, R. C.; Kozhukhov, V. N. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 567-77(Jan.-Feb. 1969).

Translated from Astron. Zh., 45: 712-25(July-Aug. 1968).

A survey was made at 86 MHz of the radio sources contained in the 3C and 3CR catalogs (560 sources in all). The observations were carried out with the DKR-1000 east–west array of the broadband cross-type radio telescope of the Lebedev Physics Institute. The values measured for the flux densities and right ascensions and the computed spectral indices for the range 86 to 178 MHz are tabulated. The mean spectral index of the extragalactic sources is 0.89 with a dispersion of 0.31. For the quasi-stellar sources the dispersion is somewhat greater than average. Several sources exhibit an increase in spectral index with increasing wavelength. (auth)

16590 FREQUENCY DEPENDENCE OF POLARIZATION OF PULSAR CP 0328. Goldstein, S. J. Jr.; Meisel, D. D. (Univ. of Virginia, Charlottesville). Science, 163: 810-12(Feb. 21, 1969).

The circularly polarized emission from the pulsar CP 0328 has an approximately flat spectrum in the 1-MHz band centered at 113.6 MHz, whereas the linearly polarized emission varies with frequency and from pulse to pulse. A simple model for the source that has a constant Faraday rotation measure fits some of the linearly polarized spectra observed for individual pulses, but changes in the rotation measure of as much as 30 radians per square meter are required between adjacent pulses. The simple model does not fit the average spectrum of the linearly polarized emission, although the average spectrum had the same form on two nights. (auth)

Solar Phenomena

Refer also to abstracts 16562, 16709, 16720, and 16863.

16591 (AD–673604) INTERPLANETARY PLASMA DENSITIES DEDUCED FROM RADAR OBSERVATIONS OF VENUS. Smith, William B.; Bowles, Kenneth L.; Shapiro, Irwin I. (Massachusetts Inst. of Tech., Lexington. Lincoln Lab.). 1968. Contract AF 19(628)-5167. 9p. (JA–3178; ESD-TR–68-210). CFSTI.

Echo delays of 50-MHz (6 meter) radar signals reflected from Venus near inferior conjunction in January 1966 have enabled the average plasma densities between Earth and Venus to be determined for the first time. Comparison of these group delays with an ephemeris produced from observations at far higher radar frequencies shows the average electron densities to vary from about 10 to 20 particles cm^3. The frequency spectra and delay profiles obtained from the reflections of the 50-MHz radar signals can also be used to study the properties of Venus' surface. (auth) (USGRDR)

16592 (AD–673911) RESEARCH DIRECTED TOWARD THE OBSERVATION AND INTERPRETATION OF SOLAR PHENOMENA. Final Report, May 1, 1967–April 30, 1968. Bell, Barbara; DeMastus, Howard L.; Menzel, Donald H. (Harvard Coll. Observatory, Cambridge, Mass.). May 1968. Contract F 19628-67-C-0247. 19p. (AFCRL–68-0316). CFSTI.

Research at Harvard in two major categories is described: (1) Analyses of solar observations made at Sacramento Peak and elsewhere of the green coronal line, and of sunspots. (2) Theoretical studies in magnetohydrodynamics, leading toward development of a model for sunspots, and in atomic theory, on the intensities of spectral lines for improved interpretation of the solar spectrum. The second section reviews the operation at Sacramento Peak of the optical solar patrols of flares in the light of Hα, of sunspots in white light, and of the coronal emission lines by spectrograph and cinematograph; it also notes a photographic observation of a flare in white light. (auth) (USGRDR)

16593 (N–68-31506) SOLAR PARTICLE OBSERVATIONS FROM JANUARY 24–FEBRUARY 24, 1967. Innanen, William G. (State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy). Feb. 1968. Contract NAS5-9076. 100p. (NASA-CR–95984). CFSTI.

Thesis.

Solar particle observations were taken from Explorer 33 and Mariner 4 satellites. The detection apparatus consisted of Geiger–Mueller tubes and solid state surface barrier detectors. The time period observed is considered in three parts beginning 28 January, 1 February, and 13 February, 1967. Proton and electron flux level measurements are related to solar flare activity and the interplanetary magnetic field structure. Polar cap absorption data are also correlated with particle observations. The proton to alpha particle ratio was noted to remain relatively constant during the observed intensity variations except for two ratio maxima noted on 15–16 February. Counts/second versus time graphs present the observed data. (STAR)

16594 (N–68-35493) PRELIMINARY RESULTS OF THE UNIVERSITY OF CALIFORNIA X-RAY EXPERIMENT ON THE OSO-3. Peterson, Laurence E.; Hudson, Hugh S.; Schwartz, Daniel A. (California Univ., La Jolla, San Diego). Nov. 1967. Contract NAS5-3177. 28p. (NASA-CR–96950; UCSD-SP–67-10). CFSTI.

Operational status and some preliminary results are presented for an x-ray experiment on the Orbiting Solar Observatory, OSO-III, which was launched March 8, 1967. The detector, consisting of a 5-mm-thick scintillation counter of about 10 cm^2 area surrounded by an anticoincidence shielding collimator, is arranged to look radially outward from the OSO wheel and scan across the Sun, sky, and Earth with every nominally 2-sec wheel rotation. Data on cosmic and solar x rays, obtained during the first three months of the experiment's operation, are discussed. Approximately two weeks of solar data were examined, and the outstanding characteristic of the Sun in the hard x-ray region is its variability. Observations of the quiet Sun and of many small bursts are noted. (STAR)

16595 ^{244}Pu IN THE EARLY SOLAR SYSTEM. Kuroda, P. K. (Univ. of Arkansas, Fayetteville). Nature (London), 221: 726-9(Feb. 22, 1969).

It is stated that recent studies on the abundances of ^{244}Pu and ^{129}I in the early solar system support the continuous galactic

nucleosynthesis theory. The agreement between the two "nuclear clocks" is excellent. (auth) (UK)

16596 LINE IDENTIFICATIONS IN THE SUN. Pierce, A. Keith (Kitt Peak National Observatory, Tucson, Ariz.). pp 461-83 of Beam-Foil Spectroscopy. Vol. II. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.2).

Sixty-three elements contribute 17,000 Fraunhofer lines to the solar spectrum in the wavelength region λλ2950 to 8770 Å. Approximately 8,000 additional lines are unidentified. Much more laboratory work and classification of faint lines of common elements, as well as more detailed studies of molecular bands, is required for further progress. Identifications based on one or two lines need further investigation. (auth)

16597 LINE IDENTIFICATIONS IN THE SOLAR EXTREME ULTRAVIOLET AND X-RAY REGIONS. Tousey, Richard (Naval Research Lab., Washington, D. C.). pp 485-524 of Beam-Foil Spectroscopy. Vol. II. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.2).

Identification of lines in the solar spectrum in the region from 3000 Å down to about 1 Å is reviewed. The current situation is summarized by a diagram showing the ions detected in the sun as of 1967. No lines of Li, Be, B, F, or Cl have been found in this region. All stages of the elements C, N, and O are recorded, and Si and Fe are well represented. When isoelectronic sequences are considered, the Lyman series of hydrogenic ions and the He sequence are well filled out. The Ne and F sequences are almost completely absent. It is suggested that more laboratory spectroscopic research in this region is needed. (30 references) (A.G.W.)

16598 TIME–LATITUDE FINE STRUCTURE OF THE OCCURRENCE OF FLARES (1942–1965). Krivsky, L. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech., 19: 365-70(1968).

The fine structure of the distribution of flare positions was investigated by plotting them, as dots, into a time–latitude chart. The results obtained are discussed. It has again been confirmed that as to flare activity, there exist superior regions made up of more conjugate regions of sunspot groups. (auth)

16599 DECREASE IN THE NUMBER OF SOLAR FLARES AND SUNSPOTS NEAR THE CENTRAL MERIDIAN. Kopecky, M. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech., 19: 364-5(1968).

It is shown that the decrease in the number of observed flares near the central meridian is paralelled by the same decrease in the number of observed spot groups. Thus is obtained a more general law governing the manifestations of solar activity whose interpretation calls for a more general approach. (auth)

16600 ON THE DETERMINATION OF THE DISSIPATION TIME OF A SUNSPOT MAGNETIC FIELD. Kopecky, V. (Inst. of Plasma Physics, Prague). Bull. Astron. Inst. Czech., 19: 362-3(1968).

An attempt is made to remove the vagueness in the dissipation time of sunspot magnetic field expressed so far, by either Cowling's or Chandrasekhar's formula. The dissipation time is determined as the time needed by the magnetic field in the center of the spot to shrink to a certain minimum value. On a number of functions modeling the variation in the magnetic field it is shown that, for a greater part of spots, the dissipation time comes close to the time determined according to Chandrasekhar's formula. (auth)

16601 SYNOPTIC MAPS OF THE CHROMOSPHERE AND OF SUNSPOTS. Martres, Marie-Josephe (Observatoire de Meudon, France). Astronomie, 82: 37-40(Jan. 1968). (In French).

A description is given of the solar maps published by "L'Astronomie," which furnish concise information concerning the position and average size of sunspots, facula plages, and filaments observed in the course of each synodic rotation of the Sun. The general layout of these maps is outlined with reference to the system of coordinates, the days of observation, and the method of representing the phenomena. (IAA)

16602 PRESSURE BALANCE BETWEEN SOLAR WIND AND MAGNETOSPHERE. Schield, M. A. (Rice Univ., Houston, Tex.). J. Geophys. Res., 74: 1275-86(Mar. 1, 1969).

An evaluation of the subsolar pressure balance between the solar wind and the geomagnetic field shows that the average proton density of the quiet-day solar wind (300 to 400 km/sec) should be between 6 and 10 p/cm^3. Even during storm times the proton density should always be between 2 p/cm^3 and 70 p/cm^3. The relation between the interplanetary solar-wind parameters and the stagnation pressure is reviewed. The subsolar geomagnetic field, including the quiet-day ring current field, is evaluated as a function of subsolar distance. The quiet-day ring current is based on the dipole gradient-drift motion of the low-energy protons observed by Davis and Williamson and by Frank. This quiet-day ring current has a magnetic moment of 0.26 M_E and produces a 41-γ decrease at the Earth's surface. A geomagnetic field normalization of observed boundary distances is also proposed to remove the effects of the dipole tilt to the solar wind. (auth)

16603 SUDDEN INCREASES IN COSMIC-RAY INTENSITY. Anda, R.; Aparicio, B.; Sud, L. V.; Zubieta, M. (Univ. Mayor de San Andres, La Paz, Bolivia). Aust. J. Phys., 22: 127-9 (Feb. 1969).

Attempts to detect sudden increases in cosmic-ray intensity not related to formations on the visible side of the Sun are described. In the present work, the pressure-corrected hourly neutron data of 1966 from widely distributed stations were subjected to analysis, i.e., increases of the type $I_{i+1} - I_i \geq 1\%$, where $i = 1, 2, 3, \ldots, 24$, were sought. No particular days were selected, but all the data were subjected to this analysis. (W.D.M.)

16604 135 TO 1650 keV SOLAR PROTONS AFTER THE FLARE OF JULY 7, 1966, OBSERVED IN THE MAGNETOTAIL AND MAGNETOSHEATH. Konradi, Andrei (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 74: 1158-63 (Mar. 1, 1969).

Protons with energies E > 135 keV were observed in the tail of the magnetosphere after the flare of July 7, 1966. These protons have an isotropic pitch-angle distribution. The maximum intensity of the protons reached $\sim 1.2 \times 10^4$ (cm^2 sec ster)$^{-1}$ for particles with P > 15 MV between 1000 and 1100 UT and 1400 and 1500 UT July 8, 1966. The energy spectrum of the protons expressed as an exponential in rigidity indicates a monotonic softening: the characteristic rigidity, P_0, changing from about 50 to 10 MV. An hour-long excursion of the satellite into the magnetosheath during the peak of the proton flux showed that the proton intensity is lower in the magnetosheath than in the magnetosphere by a factor of 2. The observed pitch-angle distribution is flat in both regions. (auth)

16605 SOLAR COSMIC RAYS OF JULY 13, 1961. Ahluwalia, H. S. (Univ. of New Mexico, Albuquerque). J. Geophys. Res., 74: 1230-7(Mar. 1, 1969).

The results of a detailed phenomenological study of the characteristics of the conspicuous increase in the flux of the low-energy protons, observed aboard Injun 1 after the sudden commencement magnetic storm of July 13, 1961, are presented. Distinguishing features of this increase were re-examined in reference to the associated solar, interplanetary, and geophysical phenomena. This study leads to a belief that the observed post-sc increase in the flux of low-energy protons was either the manifestation of a "quasi-trapped" component of solar cosmic rays temporarily confined within the "microstructures" in a blast wave or else these protons were part of the energetic particles being generated on the Sun for several tens of hours after the visible traces of the optical solar flare had vanished. It is concluded that the evidence presently available indicates that the latter possibility is perhaps more generally favored by nature. Arguments are presented against the hypothesis that the protons participating in the post-sc increase of July 13 might have been of interplanetary origin. (auth)

16606 MEASUREMENTS OF THE ELECTRON CONTENT OF THE INTERPLANETARY MEDIUM BETWEEN EARTH AND VENUS. Campbell, D. B.; Muhleman, D. O. (Cornell Univ., Ithaca, N. Y. Arecibo Ionospheric Observatory, Puerto Rico). J. Geophys. Res., 74: 1138-43(Mar. 1, 1969).

Observations of the relative propagation time of radar pulses to Venus for two frequencies, 40 MHz and 430 MHz, give the columnar electron content between the radar site and the surface of the planet. An independent measurement of the electron content of the Earth's ionosphere allows one to obtain the electron content of the interplanetary medium. Assuming an inverse square law for the electron concentration between the orbits of Venus and Earth electron concentrations at 1 AU are obtained ranging from 0.9 el cm^{-3} to 8.8 el cm^{-3} with an average over the thirteen days' observations of 4.5 el cm^{-3}. (auth)

16607 PARAMETERS FOR SHOCK WAVES GENERATING TYPE II SOLAR RADIO BURSTS, AND FOR CORONAL MAGNETIC FIELDS. Zaitsev, V. V. (Gorky Univ., USSR). Sov. Astron. AJ (Engl. Transl.), 12: 610-14(Jan.-Feb. 1969).

Translated from Astron. Zh., 45: 766-72(July-Aug. 1968).

An analysis was made of the problem of establishing the parameters of shock waves and the regular magnetic field above an active region in the corona from the dynamic spectra of type-II bursts. For the undisturbed distribution of electron concentration in the corona, a model based on simultaneous spectroscopic and interferometric observations of type-III bursts was adopted. The distribution of Mach numbers, shock-wave velocities, and magnetic fields in the corona was calculated for the height range from 300,000 to 1,500,000 km above the photosphere. (auth)

16608 MEAN ABSOLUTE ENERGY DISTRIBUTION IN THE SOLAR SPECTRUM FROM 1800 A TO 4mm, AND THE SOLAR CONSTANT. Makarova, E. A.; Kharitonov, A. V. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 599-609(Jan.-Feb. 1969).

Translated from Astron. Zh., 45: 752-65(July-Aug. 1968).

Mean values for the energy distribution in the solar spectrum over the range from 1800 Å to 4 mm were derived from over 30 independent series of measurements now available. The radiant intensity of the Sun was obtained for the entire disk in the integrated spectrum, for the center of the disk in the continuum, for the center of the disk in the integrated spectrum, and for the entire disk in the continuum. The accuracy of the results is estimated. Since a large number of completely independent measurements were averaged, the results appear to be free from large concealed systematic errors. The solar constant is equal to 2.03 ± 0.05 cal/cm^2 · min. Values averaged from many investigations are given for the coefficients describing the limb darkening of the solar disk and the influence of absorption lines on the intensity of the spectrum, as well as the spectral illuminance produced by the Sun at the mean distance of the Earth from the Sun, and the Sun's brightness temperature. The energy distribution of the solar continuum exhibits distinct "waves" —departures from the smooth curve that would have been observed if the absorption in the solar atmosphere were determined solely by negative hydrogen ions. The waves occur in the λλ 4600 to 5300 and 6800 to 7400 Å regions, and near 1.5 μ. The maximum of the energy distribution is reliably established as falling at λ 4300 Å. (auth)

16609 NUCLEAR REACTIONS AND THE LINE SPECTRUM OF SOLAR-FLARE GAMMA RAYS. Kuzhevskii, B. M. (Moscow Univ.). Sov. Astron. AJ (Engl. Transl.), 12: 595-8(Jan.-Feb. 1969).

Translated from Astron. Zh., 45: 747-51(July-Aug. 1968).

A discussion is given of the line spectrum of the γ rays from a solar flare arising through excitation of various levels in nuclei in the solar atmosphere by high-energy protons accelerated in the flare. For γ quanta in the energy range from 1.37 ≈ 20.1 MeV the total flux would be ≈0.16 photons cm^{-2} sec^{-1} at the Earth's orbit. In individual lines the flux ranges from $5.6 \cdot 10^{-5}$ to $6.2 \cdot 10^{-2}$ photons cm^{-2} sec^{-1} With neon as an example, the possibility of using individual γ-ray lines for determining the chemical composition of the solar atmosphere is considered. Various assumptions regarding the parameters of a flare (dimensions, density) are analyzed. (auth)

16610 DYNAMICS OF A MAGNETIC FIELD IN A TURBULENT MEDIUM. Vainshtein, S. I. (Central Astronomical Observatory, Pulkovo, USSR). Sov. Astron. AJ (Engl. Transl.), 12: 589-94 (Jan.-Feb. 1969).

Translated from Astron. Zh., 45: 738-46(July-Aug. 1968).

An analysis was made of the behavior of a weak magnetic field in a bounded conducting medium in which turbulent motion is excited, for null boundary conditions. The inverse action of the magnetic field on the velocity field was neglected. Support is provided for the assumption that under the conditions of homogeneous and isotropic turbulence maintained by external emf's, a steady state will be established. This assumption yields spectral functions $G_H(k)$ for the magnetic-energy density in the cases $\nu_m = \nu$ and $\nu_m \ll \nu$ in agreement with previous work. If external emf's are absent the equation for $G_H(k,t)$ coincides with the equation for the spectral function of the field of a scalar admixture gradient for arbitrary ν_m/ν. An estimate is also obtained for the decay time of a strong magnetic field, using a simplified turbulence model. (auth)

16611 DERIVATION OF ISOPHOTES FOR EXTENDED CELESTIAL OBJECTS BY THE PHOTOGRAPHIC EQUIDENSITOMETRY METHOD. Breido, I. I.; Ermoshina, K. P. (Central Astronomical Observatory, Pulkovo, USSR). Sov. Astron. AJ (Engl. Transl.), 12: 686-95(Jan.-Feb. 1969).

Translated from Astron. Zh., 45: 865-77(July-Aug. 1968).

An equidensitometry method based on the Sabatier photographic effect enables a detailed system of isophotes exhibiting the photometric structure of an object to be drawn quite rapidly and without complex equipment. The application of the method is illustrated by photometry of plates of various objects —a nebula, a comet, the solar corona, and sunspots. A continuous photometric wedge of NS-9 neutral gray glass may be used for calibrating the equidensity curves. (auth)

16612 INTEGRAL PROPERTIES OF FORCE-FREE FIELDS. Molodenskii, M. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 585-8(Jan.-Feb. 1969).

Translated from Astron. Zh., 45: 732-7(July-Aug. 1968).

A restriction on the rate of decline of force-free magnetic fields is obtained from the virial theorem. It is shown that the energy of fields that are everywhere force-free is represented by an integral diverging no more slowly than r · const. Several integral relations are derived that can serve as criteria for the force-free character of sunspot magnetic fields. (auth)

16613 FLARES, FILAMENTS, AND LOOP PROMINENCES. II. Slonim, Yu. M. (Astronomical Inst., Tashkent). Sov. Astron. AJ (Engl. Transl.), 12: 578-84(Jan.-Feb. 1969).

Translated from Astron. Zh., 45: 726-31(July-Aug. 1968).

The developmental pattern of powerful flares is investigated, along with the role of filaments in the evolution of powerful flares. It is suggested that a flare bursts forth in the magnetic envelope of the filament, showing up in the glow of the filament as a characteristic loop tunnel. Two types of flares are considered: one associated with a slow expansion of the loop tunnel, the other with an explosion of the loop tunnel. It is shown that ejections of chromospheric plasma often proceed along routes traced by filaments earlier in the active region. This is evidence that an eruption actually reflects the rapid decay of the magnetic field responsible for forming the filament earlier. (auth)

Galaxies

16614 FURTHER COMMENTS ON THE RING AROUND M81. Arp, Halton. Sov. Astron. AJ (Engl. Transl.), 12: 715-18(Jan.-Feb. 1969).

Translated from Astron. Zh., 45: 904-5(July-Aug. 1968).

Evidence from radio observations is cited to show that the faintly luminous ring around M81 is synchrotron emission arising from electrons exploded from M82. (auth)

16615 H II REGIONS IN TWENTY NEARBY GALAXIES. Hodge, Paul W. (Univ. of Washington, Seattle). Astrophys. J., 18: Suppl. Ser. No. 157, 73-84(Mar. 1969).

An atlas of H(II) regions in twenty nearby galaxies, based on plates from the Lick 120-inch and Palomar 48-inch telescopes, is abstracted from the results of a survey of ninety galaxies. The data are given in three forms: (a) as comparisons between photographs in visual light with composite photographs in Hα minus visual light, (b) as charts drawn from the photographs, and (c) as tabulated positions that give coordinates of each H(II) region measured in seconds of arc in a rectangular coordinate system centered at the galaxy center. (auth)

Cosmology

Refer also to abstract 16686.

16616 (JINR-P2-4151) QUANTUM THEORY OF SCALAR FIELD IN AN ISOTROPIC WORLD. Bronnikov, K. A.; Tagirov, E. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 20p. (In Russian). Dep.

The Fock representations are constructed for a free scalar field in a closed and quasi-Euclidean isotropic cosmologic model. The invariance of their cyclic vector under motions and the correspondence principle single out a class of unitary equivalent representations. (auth)

16617 (N-68-34691) ISOTROPIC GAMMA RADIATION AND THE METAGALACTIC COSMIC-RAY INTENSITY. Stecker, F. W. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Aug. 1968. 7p. (NASA-TM-X-63329; X-641-68-341). CFSTI.

Under various assumptions as to the time dependence of the metagalactic cosmic-ray flux and the proper cosmological model describing the Universe, OSO-3 data are used to place upper limits on the metagalactic cosmic-ray intensity. An equation is derived for the differential metagalactic gamma-ray flux in a Friedmann-type expanding universe with a Robertson–Walker metric. Numerical solutions to this equation were obtained for various models in order to determine the present metagalactic cosmic-ray intensity, I_0, needed to produce a gamma-ray flux above 100 MeV of 1.1×10^{-4} cm^{-2} sec^{-1} sr^{-1}. The flux I_0, is tabulated as a fraction of the galactic cosmic-ray flux, I_g. The results indicate: (1) A constant leakage model would require very high fluxes of metagalactic cos-

mic rays in order to explain the OSO-3 data. (2) It would be more reasonable to consider some evolving source or burst model implying high cosmic-ray production in the past when the gas density was greater and interactions were correspondingly more frequent. A present gas density of 10^{-5} cm^{-3} would also allow a more easily acceptable explanation of the OSO-3 data in terms of secondary meson production. (STAR)

16618 COVARIANT BLACK-BODY AND THE 3°K RADIATION FIELD. Alexanian, M. (Univ. of California, Livermore). Nuovo Cim., Lett., 1: 75-8(Jan. 11, 1969).

The discovery of a 3°K cosmic background radiation, which may be filling the whole of space, has added some foundation to some early cosmological theories. Hence, a thorough study of the features of this radiation cannot but add considerably to the knowledge of the Universe. One of the first questions which arises is the effect of the relative motion between an observer and the frame of reference where the radiation is "at rest." This can most easily be answered by expressing the photon equilibrium distribution in covariant form. (W.D.M.)

16619 RECENT DEVELOPMENTS IN COSMOLOGY. Narlikar, J. V. (Kings Coll., Cambridge, Eng.). Symp. Theor. Phys. Math., 6: 65-80(1968).

Topics discussed include relativistic cosmology, age of the Universe, the steady-state model, tests of cosmological models, the arrow of time, the red-shift–distance relation, counting of radio sources, background radiation, helium/hydrogen ratio, formation of galaxies, and the oscillating Universe. (W.D.M.)

16620 BACKGROUND RADIATION IN ISOTROPIC WORLD MODELS. Payne, A. D. (Univ. of Tasmania, Australia). Aust. J. Phys., 22: 59-77(Feb. 1969).

A general equation for the extragalactic background intensity is derived for the general case of an isotropic homogeneous Universe. The extragalactic radio spectrum depends critically on the thermal history of the Universe and numerical results have been obtained for different possible models. A brief discussion is given on the conclusions drawn from the comparison of these results with the observed background spectrum. (auth)

16621 GRAVITATIONAL BOUNCE IN GENERAL RELATIVITY. Bondi, H. (European Space Research Organization, Paris). Mon. Notic. Roy. Astron. Soc., 142: 333-53(1969).

The radial motion of uniform spheres is studied in general relativity, in close analogy with the Newtonian treatment. Attention is concentrated on an equation of the energy-conservation type. Conditions are found for an initially inward motion to reverse ("bounce") for various assumed relations between density and central pressure. (auth) (UK)

16622 PLASMA MECHANISMS OF RADIATION IN ASTROPHYSICS. Kaplan, S. A.; Tsytovich, V. N. (Lebedev Inst. of Physics, Moscow). Usp. Fiz. Nauk, 97: 77-118(Jan. 1969). (In Russian).

The recent rapid development of astrophysics must be attributed to discoveries made in the field of plasma physics. The chief problem is the clarification of the transformation of plasma waves into electromagnetic waves. Radioastronomical observations revealed the prevalence of high-intensity radiation mechanisms which do not follow know bremsstrahlung processes. Cosmic plasma may be easily excited, passing into a turbulent state; the high energy density of the turbulent plasma pulsations create a broad-range radiation source. The mechanisms examined are classified according to their frequency range. They include conversion during scattering on epithermal nonrelativistic ions, scattering on relativistic electrons, nonlinear scattering on epithermal relativistic ions, plasma pinch, and decay of plasma waves. (Review article, 34 references). (TTT)

Planetary Phenomena

16623 DEUTERIUM IN THE UPPER ATMOSPHERES OF VENUS AND EARTH. Donahue, T. M. (Univ. of Pittsburgh). J. Geophys. Res., 74: 1128-37(Mar. 1, 1969).

The anomalous Lyman-α glow observed by Mariner 5 between 6500 km and 9000 km from the center of Venus would imply a 10 to 1 deuterium-to-hydrogen ratio at 6500 km if it were caused by deuterium. It is pointed out here that because at 650°K the escape of deuterium is only 10^{-4} times as fast as hydrogen, this ratio may only require a planetary abundance ratio of order 10^{-3}. The argument depends on the escape flux of deuterium being determined primarily by the photodissociation rate of deuterium compounds. It is shown that if downward mixing and recombination of atoms is not to compete too seriously with escape, the eddy mixing coefficient on Venus must be much smaller than that on Earth. (auth)

16624 MODELS FOR THE NIGHTTIME VENUS IONOSPHERE. McElroy, Michael B.; Strobel, Darrell F. (Kitt Peak National Observatory, Tucson, Ariz.). J. Geophys. Res., 74: 1118-27 (Mar. 1, 1969).

Possible models for the nighttime Venus ionosphere are developed and compared with observations obtained from Mariner 5. The preferred model assumes the presence of a light reactive ion, such as He^+ or H_2^+, in the topside ionosphere, and it is shown that all features of the observed ionization profile can be accounted for with this single hypothesis. It is suggested that He^+ and, or, H_2^+ can be readily supplied by lateral transport from the dayside. Implications of the model with regard to the abundance of He and H_2 are briefly explored, and some consequences for Venus nightglow are discussed. (auth)

16625 EQUATIONS FOR THE ROTATIONAL MOTION OF PLANETS IN GENERAL RELATIVITY THEORY. Brumberg, V. A. (Inst. of Theoretical Astronomy, Leningrad). Sov. Astron. AJ (Engl. Transl.), 12: 659-67(Jan.-Feb. 1969).

Translated from Astron. Zh., 45: 828-40(July-Aug. 1968).

Equations for the rotational motion of bodies in general relativity theory are derived in explicit form on the basis of Fock's integral formulation of these equations. Unlike the equations of Newtonian mechanics, the equations obtained for the case of spherically symmetric bodies are not satisfied for vanishing angular velocities of the bodies, implying that in general relativity the translational motion of bodies will also entail a rotational motion. (auth)

16626 SOME PERIODS IN THE GRAVITATIONAL FIELD OF A ROTATING BODY. Kurmakaev, Z. Kh. (Astrophysical Inst., Alma-Ata, USSR). Sov. Astron. AJ (Engl. Transl.), 12: 655-8 (Jan.-Feb. 1969).

Translated from Astron. Zh., 45: 823-7(July-Aug. 1968).

Anomalistic and sidereal periods in coordinate time and proper time for an equatorial satellite moving in the gravitational field of a rotating body are determined approximately. An estimate is given of the value of ΔT, for a hypothetical satellite moving in a circular orbit. (auth)

16627 GAMMA RADIATION OF THE MOON AND THE COMPOSITION OF LUNAR ROCKS (BASED ON THE MEASUREMENTS TAKEN BY THE COSMIC STATION LUNA-10). Vinogradov, A. P.; Surkov, Yu. A.; Chernov, G. M.; Kirnozov, F. F.; Nazarkina, G. B. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geochem. Int. (Engl. Transl.), 4: 1030-9(1967).

Translated from Geokhimiya, No. 11, 1263-73(1967).

Ninety percent of the gamma radiation of lunar material is due to interaction with cosmic rays. The remaining 10% of the radiation stems from natural radioactive elements in the lunar crust and shows that this material corresponds to terrestrial rocks of basaltic or ultrabasic composition. A difference between the lunar maria and continents was observed. (auth)

16628 AGE OF THE CRUST AND ENTRY OF RADIOGENIC ^{4}He AND ^{40}Ar INTO THE ATMOSPHERE. Baranov, V. I.; Knorre, K. G. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geochem. Int. (Engl. Transl), 4: 1121-9(1967).

Translated from Geokhimiya, No. 12, 1418-29(1967).

Calculations, based on a chondritic Earth model, show that the crust formed early in the overall history of Earth formation. The present-day abundance of atmospheric ^{4}He can be accounted for by loss and accumulation of 5% of helium derived from decay of U and Th in the crust. Ar/He ratios of natural gases nearly match those of crustal materials but are distinct from those of mantle material, suggesting that present-day Ar and He in rocks are of crustal origin. The authors propose two principal sources of argon: (1) argon from degassing during the formation of the crust; and (2) argon of cosmic origin derived from decay of "old" ^{40}K in particles of the protoplanetary cloud. (auth)

Atomic and Molecular Physics

Refer also to abstracts 15873, 16560, 16561, 16897, 16910, 17058, and 17059.

16629 (D-1-82-768) LABORATORY MEASUREMENTS OF PHOTOIONIZATION, PHOTOEXCITATION, AND PHOTODETACHMENT. Schoen, Richard I. (Boeing Scientific Research Labs., Seattle, Wash. Geoastrophysics Lab.). Oct. 1968. 82p. (CONF-680948-1).

From Symposium on Laboratory Measurements of Aeronomic Interest, Toronto, Canada.

Laboratory measurements of ionization, fluorescence, and photodetachment are reviewed. Only molecules of aeronomic interest are included; atoms are excluded. The section on photo-

detachment includes only work that has appeared since 1964. Current data are presented on photoionization cross sections, dissociative ionization cross sections, cross sections for the excitation of particular states of ions, relative vibrational excitation probabilities, photodetachment cross sections, angular distributions of electrons from photoionization and dissociative excitation of neutral molecules. Some suggestions are made for further work. (78 references) (auth)

16630 (N-68-31661) CONTRIBUTION OF PERTURBER RADIATION TO THE SHAPES OF SPECTRAL LINES BROADENED BY ELECTRON IMPACTS. Burgess, D. D. (Harvard Coll. Observatory, Cambridge, Mass.). July 1968. 44p. (NASA-CR-96147; SR-29). CFSTI.

Theories of electron-impact broadening have previously neglected the radiation produced by the perturbing electrons. In this paper a theory is developed to take the perturber radiation into account, and so to evaluate possible interference terms. These may lead to observable asymmetries of lines of ionized emitters. (auth)(STAR)

16631 (N-68-32562) IONIZATION OF IONS. Thomas, Brian K.; Garcia, J. D. (Pittsburgh Univ., Pa. Space Research Coordination Center). Aug. 14, 1968. 23p. (NASA-CR-96233; SRCC-83). CFSTI.

The classical binary encounter model for ionization by charged particle impact is modified to permit evaluation of the cross section for ionization of positive ions by electron impact. General scalable expressions are obtained and compared with available experimental data and quantum theoretical approximations. The dependence on ionic charge is discussed, and a simple physical interpretation emerges. Results indicate that this model is as reliable as the Born approximation for this process; i.e., they agree very well with experiments for energies much larger than threshold and are everywhere within a factor of two. (auth) (STAR)

16632 (ORNL-TM-2406) LOW ENERGY ELECTRON BEAM STUDIES IN THIN METAL FILMS. Garber, F. W.; Harter, J. A.; Birkhoff, R. D.; Ritchie, R. H. (Oak Ridge National Lab., Tenn.). Feb. 1969. Contract W-7405-eng-26. 130p. Dep. CFSTI.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

An experimental investigation is reported of the interactions of low-energy electrons in thin metal foils of aluminum and sodium. The target system consisted of a thin metal top foil, an anodically produced Al_2O_3 layer of 75 Å, and a bottom aluminum foil approximately 2000-Å thick, all supported by a glass substrate. Transmission of the top metal foil was determined by measuring the electron currents in both metal foils while the system underwent monoenergetic electron irradiation. Data are presented for top foils vacuum-evaporated under ultrahigh vacuum and high vacuum. In all cases the top foil was not exposed to the atmosphere prior to data taking. The electron beam was normally incident upon the target system. The transmission of aluminum was studied for top-foil thicknesses between 67 and 525 Å and over an energy range from 1 eV to 4 keV. Analysis of the data yielded estimates of the electron attenuation length in aluminum for electron energies between 50 and 300 eV of 128 to 49 Å, respectively. The electron stopping power was determined in the energy range between 300 eV and 1 keV and varied between 3.06 and 4.84 eV/Å. A charge equilibrium distance of between 67 and 380 Å has also been determined for aluminum. Data are given for top foils of sodium of thicknesses 1593, 7376, and 9736 Å; the data are discussed in general terms. A Monte Carlo code using theoretical inverse mean-free-path calculations is also described and was used to generate data analogous to the experimentally measured transmission curves. The results of the Monte Carlo calculations were compared with the experimental results and satisfactory agreement was obtained in most cases. (auth)

16633 (SC-T-69-1007) ON SOME PECULIARITIES OF THE TRANSFER OF ROTATIONAL AND VIBRATIONAL ENERGIES IN PROCESSES OF ION-MOLECULAR COLLISIONS. Polyakova, G. N.; Fogel, Ya. M.; Erko, V. F.; Zats, A. V.; Tolstolutskii, A. G. Translated by Marcel I. Weinreich (Sandia Labs., Albuquerque, N. Mex.), from Zh. Eksp. Teor. Fiz., 54: 374-83(1968). 17p. Dep. CFSTI.

An abstract of the original Russian article appeared as NSA 22: 21895. (M.H.R.)

16634 CALCULATION OF CROSS SECTIONS FOR ELECTRON-HELIUM COLLISIONS. Michels, H. H.; Harris, F. E.; Scolsky, R. M. (United Aircraft Research Labs., East Hartford, Conn.). Phys. Lett., 28A: 467-8(Jan. 13, 1969).

The elastic scattering of electrons from helium is studied using analytic procedures for representing the electronic wave function. Total elastic and momentum transfer cross sections are calculated and compared with experiment. The first scattering resonance in the elastic channel is examined. (auth)

16635 BEAM-FOIL SPECTROSCOPY. VOLUME I. Proceedings of the Conference held at the University of Arizona, November 20-22, 1967. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968. 415p. $42.50 (Vols. I and II). (CONF-671138-(Vol.1)).

Separate abstracts were prepared for 15 of the 17 papers included in this volume. Two papers were evaluated as not in scope for NSA. (A.G.W.)

For abstracts of individual papers see: 16637-16651.

16636 SECONDARY ELECTRON EMISSION FROM A MOLYBDENUM TARGET BOMBARDED BY MULTICHARGED IONS. Perdrix, M.; Paletto, S.; Goutte, R.; Guillaud, C. (Institute National des Sciences Appliquees, Villeurbanne, France). Phys. Lett., 28A: 534-5(Jan. 13, 1969). (In French).

The kinetic emission of a metallic target bombarded with ions of noble gases varies linearly with the velocity and does not depend on the charge of the incident ion. (auth)

16637 GENERAL REVIEW OF BEAM-FOIL SPECTROSCOPY. Bashkin, Stanley (Univ. of Arizona, Tucson). pp 3-43 of Beam-Foil Spectroscopy. Vol. I. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.1).

Recent developments in the field of beam-foil spectroscopy are reviewed. The production and analysis of the light source used are examined in some detail. Some illustrative results are shown. Emphasis is on problems encountered. Possible future uses of beam-foil work are suggested briefly. (A.G.W.)

16638 FOIL- AND GAS-EXCITATION OF SODIUM SPECTRA. Brown, Louis (Carnegie Institution of Washington, Washington, D. C.); Ford, W. Kent Jr.; Rubin, Vera; Traechslin, Walter; Brandt, Werner. pp 45-77 of Beam-Foil Spectroscopy. Vol. I. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.1).

A beam of singly charged, 0.9-MeV sodium ions was excited in one case by passing it through a thin carbon foil and in another by passing it into low-pressure helium. The light from the glowing beam was analyzed with a spectrograph equipped with an image intensifier. A total of 88 lines was observed in the spectral range from 2.1 to 2.9 eV, of which five are identified as resulting from known transitions. Experimental methods of determining the lifetime of the excited state and the charge state of the atom emitting a given line are reported with measurements. The spectra are discussed in terms of statistical models. (auth)

16639 ION BEAM SPECTRA OF IRON. Whaling, Ward; King, R. B.; Smith, P. L. (California Inst. of Tech., Pasadena). pp 81-100 of Beam-Foil Spectroscopy. Vol. I. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.1).

Ion beam spectra of iron obtained by passing a beam of iron ions from a Van de Graaff accelerator through a carbon foil have been photographed in the region 3377 to 6500 Å with an f/3 astronomical prism spectrograph giving a dispersion of 110 Å/mm at H_γ. Radiation emitted from beams of 0.5, 0.75, 1.0, and 1.5 MeV shows progressive changes in the lines emitted. At 0.5 MeV almost all the lines are identified at Fe I lines with large gf-values. At higher energy these lines weaken and other lines, as yet unidentified, appear and become very strong. Measurements of the relative numbers of different ions in the beams indicate that at the higher energies ions of charge 4, 5, and 6 predominate. No terms are known in these ionic spectra that could give rise to the lines observed. (auth)

16640 SPECTROSCOPY WITH GAS TARGETS. Hughes, R. H. (Univ. of Arkansas, Fayetteville). pp 103-20 of Beam-Foil Spectroscopy. Vol. I. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.1).

The use of spectroscopy of fast-ion impact with gas targets to study emissions from the fast atoms resulting from electron capture or dissociation of the incident ion are reviewed. Some results are given on electron capture by H^+ to produce various states of H atoms and on production of H atoms in the 3s state by dissociation of H_2^+ and H_3^+ projectiles on impact with gases. Measurements being carried out on polarization of radiation emitted upon capture of an electron by fast protons are discussed briefly. (A.G.W.)

16641 BEAM SPECTROSCOPY AT TANDEM ENERGIES. Jordan, J. A. Jr. (Rice Univ., Houston, Tex.). pp 121-56 of Beam-Foil Spectroscopy. Vol. I. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.1).

Beam spectroscopy at energies greater than 5.5 MeV is discussed. Emphasis is placed on the capabilities and limitations of the tandem Van de Graaff accelerator for beam-foil experiments. The problems associated with high-velocity weak beams and various techniques to enhance intensity and improve resolution in observed spectra are discussed. (auth)

16642 CHARGE-STATE DISTRIBUTIONS OF Br AND I IONS EMERGING FROM SOLIDS AND GASES IN THE ENERGY RANGE 20 TO 150 MeV. Moak, C. D.; Bridwell, L. B.; Lutz, H. O.; Datz, S.; Northcliffe, L. C. (Oak Ridge National Lab., Tenn.). pp 157-74 of Beam-Foil Spectroscopy. Vol. I. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.1).

Monoenergetic bromine and iodine ions from the Oak Ridge tandem accelerator and an MP tandem accelerator were used to investigate the variations of ionic charge states with various target materials. Beams containing a single charge state and energy were obtained by magnetic analysis and passed through solid targets or windowless gas targets before passing through an electrostatic analyzer. Targets used included carbon foils of various thicknesses and hydrogen, helium, argon, krypton, neon, and SF_6 gases at various pressures. It was found that the charge-state distributions for solids are centered at much higher values of ion charge than those for gases, and differences among the solids as a class and among the gases as a class are minor compared to the solid–gas difference. The so-called condensation effect was seen to be a major factor. (A.G.W.)

16643 SPECTRUM AND YIELD OF ELECTRONS EMITTED WHEN HEAVY IONS PASS THROUGH METAL FILMS. Haines, E. L.; Whitehead, A. B.; Parker, R. H. (California Inst. of Tech., Pasadena). pp 177-92 of Beam-Foil Spectroscopy. Vol. I. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.1).

The spectrum and yield of electrons emitted when heavy ions pass through metal films were measured. Evaporated metal films of Be, Ni, and Au were contained in an electrostatic lens that focused and accelerated the electrons. The electrons were collected by a calibrated surface barrier detector. The use of a suppression grid in a similar lens provided an integral energy spectrum. The experimental results are interpreted in terms of Lindhard's stopping theory and Sternglass' theory of electron emission. Agreement is found with Bohr's prediction that most of a heavy ion's energy is lost in close, δ-producing collisions, and very little in distant resonant collisions. (auth)

16644 STARK-INDUCED ANTICROSSING IN THE n = 4 TERM OF SINGLY IONIZED HELIUM. Eck, T. G.; Huff, R. J. (Case Western Reserve Univ., Cleveland). pp 193-202 of Beam-Foil Spectroscopy. Vol. I. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol. I).

Helium ions in the n = 4 term are produced by bombardment of neutral helium by an electron beam that moves parallel to a variable magnetic field. A dc electric field is applied perpendicular to the electron beam. Signals associated with the intersection of Zeeman levels coupled by the electric field are detected by monitoring the 4686 Å radiation (n = 4 to n = 3 transition) emitted into a small solid angle at right angles to the magnetic field. The signals observed have been identified with the crossings of S levels with P, D, and F levels. The S–P, S–D, and S–F crossing signals are the result of first, second, and third order Stark coupling respectively of the two levels involved. These signals are to be used for the precise determination of the fine-structure splittings and Lamb shifts in the n = 4 term of He^+. (auth)

16645 MEASUREMENTS OF RADIATIVE LIFETIMES IN THE EXTREME ULTRAVIOLET. Heroux, L. (Air Force Cambridge Research Labs., Bedford, Mass.). pp 205-32 of Beam-Foil Spectroscopy. Vol. I. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Béam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.1).

The experimental method used to measure radiative lifetimes of emission lines in the extreme ultraviolet by the foil-excitation technique is discussed. The procedure used to correct the experimental data for the effects of cascading is illustrated by a detailed analysis of the data for the emission line He^+ 304 Å. Measurements of transition probabilities are presented for transitions of the type $1s^2\ 2s^2\ 2p^2 - 1s^2\ 2s\ 2p^3$, which appear to be free from cascading in N^+ and which are subject to cascading in O^{2+}. (auth)

16646 INTENSITY MEASUREMENTS IN THE VISIBLE AND ULTRAVIOLET. Bickel, William S. (Univ. of Arizona, Tucson). pp 233-84 of Beam-Foil Spectroscopy. Vol. I. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.1).

Equipment and techniques for measuring intensities of spectral lines in the visible and ultraviolet are reviewed with respect to beam-foil spectroscopy. Suggestions for getting a spectral line from a beam as quickly as possible are listed and discussed briefly. Correlation of the measurements with the properties of the beam and the atoms in it and the types of information obtainable are considered. (A.G.W.)

16647 ATOMIC LIFETIME MEASUREMENTS WITH PULSED ELECTRON BEAMS. Klose, Jules Z. (National Bureau of Standards, Washington, D. C.). pp 285-304 of Beam-Foil Spectroscopy. Vol. I. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.1).

Following a short discussion of the general method of measuring atomic lifetimes using pulsed electron beams, four separate determinations of the mean lives of the ten 2p levels (Paschen notation) in Ne I are presented for comparison. These four sets of results from different experimental groups are found to be in general agreement. Finally, measurements of the pressure-dependent lifetime of the $3s_2$ laser level in Ne I are analyzed using the Holstein theory of the imprisonment of resonance radiation. The analysis yields information about transition probabilities from which are derived the $3s_2$ lifetimes for absence of imprisonment (28 ± 5 nsec) and complete imprisonment (52 ± 2 nsec) of the 600.04-Å ($3s_2 - {}^1S_0$) resonance radiation. (auth)

16648 HANLE EFFECT. Happer, W. (Columbia Univ., New York). pp 305-28 of Beam-Foil Spectroscopy. Vol. I. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.1).

Use of Hanle-effect techniques for investigating excited states of atoms is reviewed. The theory of the technique, which makes use of the magnetic depolarization of resonantly scattered light, is described briefly. Examples are given of the types of information that can be obtained about excited states: the lifetime, the hyperfine-structure coupling constants, the g_J values, and the Stark-shift parameters. (A.G.W.)

16649 NEUTRAL EXCITED BEAMS PRODUCED BY CHANGE TRANSFER. Peterson, J. R.; Lorents, D. C.; Salop, A. (Stanford Research Inst., Menlo Park, Calif.). pp 329-40 of Beam-Foil Spectroscopy. Vol. I. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.1).

Beams of excited neutral atoms and molecules can be readily obtained from ion beams by means of asymmetric charge-exchange reactions in metal vapor targets. The reaction $A^+ + B \rightarrow A + B^+$ will generally produce excitation in either A or B^+ or both providing the ionization potential of A is much larger than that of B. Thus $N_2(C^3\pi_u)$ is produced by electron-capture reactions of N_2^+ in K. Results of exploratory studies of excitation produced by reactions of this type are discussed. This method of producing excited beams is obviously applicable to the measurement of radiative lifetimes. Problems of cascading are largely avoided, and as with the beam-foil method, collisional deactivation and wall effects are negligible. Lifetimes in the approximate range 2×10^{-8} to 2×10^{-5} sec can be measured. (auth)

16650 DECAY CURVES OF SOME N II, N III, N IV LEVELS EXCITED BY THE BEAM–FOIL TECHNIQUE. Denis, A.; Desesquelles, J.; Dufay, M.; Poulizac, M. C. (Institut de Physique Nucleaire, Villeurbanne, France). pp 341-69 of Beam-Foil Spectroscopy. Vol. I. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.1).

The light emitted by fast particles produced by a Van de Graaff 2-MeV accelerator and excited by passage through a thin carbon

foil has been studied in the wavelength range 2000 to 6000 Å. With a nitrogen beam, numerous N II, N III, N IV, and N V transitions have been observed at energies from 1 to 2 MeV. By means of a moving monochromator (with slits perpendicular to the beam) and an EMI 6256S photomultiplier, the decay of the intensity of about 40 lines has been continuously recorded on a length of 25 cm along the axis of the beam. The apparent lifetimes and the relative populations of the upper levels have been calculated and are presented in a preliminary table. The effects of the cascades and of the residual gas are analyzed. The results are compared with the theoretical values of the transition probabilities. (auth)

16651 STUDY OF HYDROGEN LYMAN α RADIATION USING THE BEAM-FOIL EXCITATION METHOD. Chupp, E. L.; Dotchin, L. W.; Pegg, D. J. (Univ. of New Hampshire, Durham). pp 371-82 of Beam-Foil Spectroscopy. Vol. I. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol. 1).

The intensity of Lyman-α radiation emitted from free excited hydrogen atoms has been investigated using the beam-foil excitation method. An excited atom beam of hydrogen was obtained by passing H_3^+ ions (340 keV) through thin carbon foils of thicknesses 5, 20, and 40 $\mu g/cm^2$. The intensity of the Lyman-α radiation as a function of distance downstream from the foil was measured using a 1/3-meter vacuum ultraviolet monochromator with a photomultiplier detector, normalizing all data to the signal from another photomultiplier viewing H_β fixed with respect to the position of excitation. Intensity decay curves, measured out to a distance corresponding to 10 Lyman-α lifetimes (~5 inches), clearly show that a single transition cannot describe the results. It was also noted that the shape of the decay curve is affected by the thickness of the carbon foil used in the experiment. To determine initial state populations and transition probabilities, various exponential forms have been used to determine the best fit. Decay curves were also computed using theoretical transition probabilities by varying the initial state populations for different assumed excitation conditions. (auth)

16652 BEAM-FOIL SPECTROSCOPY. VOLUME II. Proceedings of the Conference held at the University of Arizona, November 20–22, 1967. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968. 259p. $42.50 (Vols. I and II). (CONF-671138-(Vol.2)).

Separate abstracts were prepared for ten of the eleven papers included. No abstract was prepared for a paper on the Lamb shift in $^6Li^{2+}$. (A.G.W.)

For abstracts of individual papers see: 16560–16562, 16579, 16596, 16597, and 16653–16656.

16653 DEPENDENCE OF ATOMIC f-VALUES ON NUCLEAR CHARGE. Wiese, W. L. (National Bureau of Standards, Washington, D. C.). pp 385-406 of Beam-Foil Spectroscopy. Vol. II. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.2).

Conventional perturbation theory predicts a simple relationship between atomic oscillator strength and nuclear charge, which is rederived and discussed in some detail. By utilizing available f-value data for the lighter elements, it is then shown that this dependence is clearly evident in the numerical material supplied by theory as well as experiment. Several representative examples are given in graphical form and discussed. (auth)

16654 ATOMIC TRANSITION PROBABILITIES. Garstang, R. H. (Univ. of Colorado, Boulder). pp 407-23 of Beam-Foil Spectroscopy. Vol. II. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.2).

In this review of recent theoretical work on atomic transition probabilities, two directions in which attempts have been made to go beyond the usual elementary LS-coupling theory are emphasized. In the first approach, configuration interactions are included. In the second, spin effects (spin–orbit interaction and in a few cases spin–other-orbit and spin–spin interactions) are included in the Hamiltonian. This leads to intermediate coupling theory. Some examples of each approach are given, and general areas in which further study is needed by astrophysicists are listed. (A.G.W.)

16655 CURRENT STATUS OF THE LAMB SHIFT. Erickson, Glen W. (Univ. of California, Davis). pp 425-42 of Beam-Foil Spectroscopy. Vol. II. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.2).

Sources of uncertainty in calculation of the Lamb shift are reviewed, and comparisons are made with experimental results. It is concluded that there are small but potentially interesting discrepancies between the Lamb shift theory and experiments in hydrogen and deuterium, and that further experiments for $Z > 1$ would shed light on these discrepancies. (A.G.W.)

16656 PROGRESS IN PRODUCING METASTABLE STATES OF ONE-ELECTRON HEAVY IONS. Donnally, Bailey (Yale Univ., New Haven); Sellin, Ivan. pp 451-8 of Beam-Foil Spectroscopy. Vol. II. Bashkin, Stanley (ed.). New York, Gordon and Breach, Science Publishers, 1968.

From Conference on Beam-Foil Spectroscopy, Tucson, Ariz. See CONF-671138-(Vol.2).

An attempt is being made to produce a sufficient amount of C^{5+} in the 2s state to make possible a measurement of the Lamb shift. C^{5+} ions of 120 MeV from the Yale heavy-ion accelerator were passed through thin foils of Al and C and the radiation from the beam was reviewed as it traversed an electrostatic quench region downstream. A beam component that decays at a rate consistent with the expected Stark quenching of metastable 2s C^{5+} ions in the beam was detected. (auth)

16657 X-RAY SCATTERING FACTORS COMPUTED FROM NUMERICAL HARTREE–FOCK WAVE FUNCTIONS. Cromer, Don T.; Mann, Joseph B. (Los Alamos Scientific Lab., N. Mex.). Acta Crystallogr., Sect. A, 24: 321-4(Mar. 1968). (LA-DC-9168).

X-ray scattering factors for neutral atoms from He to Lw and for most of the chemically significant ions through Lu^{3+} have been computed from numerical Hartree–Fock wave functions. The results are given in the form of coefficients for an analytic function. (auth)

16658 STRUCTURE OF THE SPECTRUM OF NEUTRAL TERBIUM, Tb I. PART IV. Meinders, E.; Klinkenberg, P. F. A. (Univ., Amsterdam). Physica, 38: 253-74(Apr. 5, 1968).

A CDC 3200 computer has been put into use for extending the analysis of Tb I. The first results are a couple of odd levels found by means of self-reversed lines, and three even levels identified as $4f^85d6s^2\ ^8P_{5/2}$, $^6H_{5/2}$ and $^6F_{11/2}$. In addition $^8F_{5/2}$ has been established through a new Zeeman effect observation. Herewith the ^8F term is completed and the number of known even levels is raised from 25 to 29, with g factors experimentally determined for all of them. A complete list of Tb I lines observed in self-reversal is given and the correlation between sensitivity for reversal and classification is studied. The total number of odd levels has reached 291 and the total number of classified lines is now 3240. Prospects for finding the system based on $4f^96s^2$ are discussed in connection with reversal and temperature classification. (auth)

16659 MULTIPLE COLLISIONS OF Ar AND Cu ATOMS ON A Cu SURFACE. van der Weg, W. F.; Bierman, D. J. (FOM-Instituut voor Atoom- en Molecuulfysica, Amsterdam). Physica, 38: 406-8(May 1, 1968).

Observations have been made of the second scattering of projectile and target atoms after a collision of keV Ar^+ ions on the surface of a Cu single crystal. A simple potential model explains the results. (auth)

16660 INTRODUCTION TO MODERN PHYSICS. SECOND EDITION. Blanchard, C. H.; Burnett, C. R.; Stoner, R. G.; Weber, R. L. Englewood Cliffs, N. J., Prentice-Hall, Inc., 1969. 510p. $9.95.

Subjects covered are: classical physics, atoms and gases, electrons and ions, electromagnetic radiation, the Rutherford–Bohr atom, quantum mechanics, the structure of many-electron atoms, molecules and solids, relativity, electrons and photons, the neutron and nuclear forces, ranges and absorption, radioactivity, nuclear reactions, applications of nuclear physics, particle accelerators, and high-energy physics. (M.H.R.)

16661 ELASTIC SCATTERING OF POSITRONS BY HYDROGEN ATOMS. Rahman, M. (Atomic Energy Centre, Dacca, Pakistan); Hussain, D. Aust. J. Phys., 22: 133-4(Feb. 1969).

Elastic scattering phase shifts of slow positrons at energies below the threshold of positronium formation were calculated in an adiabatic approximation with a parameterized polarization potential (PPP) obtained by approximating the results of Reeh (1960). The results obtained were compared with existing calculations with different polarization potentials (Bransden and Jundi, 1966). It was found that the phase shifts calculated with the PPP are quite close to the values obtained by Drachman (1965) using the exact second-order polarization potential of Dalgarno and Lynn (1957). It is concluded that the simple parametrized

potential gives a fairly good description of polarization of the H atom. (W.D.M.)

16662 POSITRON ANNIHILATION IN LIQUIDS AND SOLIDS. Majumdar, C. K. (Tata Inst. of Fundamental Research, Bombay). pp 829-56 of Theory of Condensed Matter. Vienna, International Atomic Energy Agency, 1968.

See STI/PUB-205.

The processes occurring when positrons are injected into bulk matter are discussed. Selection rules of annihilation are considered, and lifetime and angular correlation measurements in experimental studies are described. The theory of positron annihilation in metals is considered. Theoretical and experimental determination of the effective mass of the positron is discussed. Finally, thermalization time and paramagnetic quenching theory are considered. (41 references) (D.L.C.)

16663 CALCULATING THE ELASTIC COLLISION CROSS SECTIONS OF ATOMS AND IONS WITH INELASTIC PROCESSES BEING TAKEN INTO ACCOUNT. Khalikova, D. Kh.; Yakovlev, L. G. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk, No. 3, 50-3(1968). (In Russian).

In the region of high energies the role of inelastic collisions is large, and should be taken into account. In search of a simple and reliable method of calculation, it is possible to go back to a general theory of scattering, in particular, to consider an "optical model." The basic idea of the model is to introduce a complex potential into the Schroedinger equation in describing the interactions between atoms. A Lennard–Jones potential is used. A formula is derived for the collision cross sections as a function of the parameter ζ which is determined experimentally for each pair of atoms. Values of the total cross sections and of the elastic cross sections as a function of the energy of the incident ion are calculated for the following pairs: (1) Ar^+ and Ar, (2) Ne^+ and Ne, and (3) He^+ and He. (TTT)

16664 TWO-PHOTON DECAY OF THE SINGLET AND TRIPLET METASTABLE STATES OF HELIUM-LIKE IONS. Drake, G. W. F. (Smithsonian Astrophysical Observatory, Cambridge, Mass.); Victor, G. A.; Dalgarno, A. Phys. Rev., 180: 25-32(Apr. 5, 1969).

The two-photon decay rates and photon energy distributions of the metastable $2\,^1S$ and $2\,^3S$ states of the helium isoelectronic sequence are calculated by variational procedures for the ions He(I) through Ne(IX). (auth)

16665 DISPERSION OF ATOMIC GYROMAGNETIC RATIOS: APPROACH TO STATISTICAL EQUILIBRIUM. Rosenzweig, N. (Argonne National Lab., Ill.); Wybourne, B. G. Phys. Rev., 180: 33-44(Apr. 5, 1969).

The dispersion of the gyromagnetic ratios about their mean value is calculated as a function of the magnitude of the spin–orbit coupling parameter for some energy matrices of the complete electrostatic and spin–orbit interactions in the f^6 and f^7 electron configurations. It follows from orthonormality alone that the dispersion assumes its greatest value in the LS-coupling limit. As the magnitude of the spin–orbit coupling is increased, the energy matrix becomes more complex, its pseudorandom character is intensified, and the value of the dispersion declines monotonically until it reaches a minimum value that corresponds approximately to a state of statistical equilibrium. Some aspects of the observed variation may be understood with the help of some schematic models for the transformation matrix connecting the LS- and intermediate-coupling schemes. The minimum values of the dispersion about the mean are roughly equal to the values predicted by a statistical model in which all of the LS components of the wave function are assumed to be statistically equivalent. (auth)

16666 LONG-RANGE BEHAVIOR OF HARTREE–FOCK ORBITALS. Handy, Nicholas C.; Marron, Michael T.; Silverstone, Harris J. (Johns Hopkins Univ., Baltimore). Phys. Rev., 180: 45-8(Apr. 5, 1969).

The widely held belief that Hartree–Fock orbitals φ_i behave asymptotically like $\exp[-(-2\times\epsilon_i)^{1/2}r]$, where ϵ_i is the orbital energy of φ_i, is shown to be incorrect, with one exception: atomic configurations consisting entirely of s orbitals. The correct asymptotic form of φ_i is a sum of terms like $\exp[-(-2\epsilon_j)^{1/2}r]$, in which all ϵ_j appear. The former misconception apparently resulted from too superficial a treatment of the exchange potential at large r. (auth)

16667 INTERATOMIC POTENTIAL MODEL FOR ION–ATOM SYSTEMS INCLUDING A CHARGE-EXCHANGE CONTRIBUTION. Menendez, M. G. (Martin Marietta Corp., Orlando, Fla. Rollins Coll., Winter Park, Fla.); Redmon, M. J.; Aebischer, J. F. Phys. Rev., 180: 69-77(Apr. 5, 1969).

A model for the interatomic potential between alkali metal ions and rare-gas atoms accounting for repulsive and attractive exchange forces has been calculated. The attractive exchange contribution is estimated using Mulliken's charge-transfer theory. The repulsive potential is calculated using Firsov's theory of interacting Thomas–Fermi–Dirac atoms. Two models, $\phi(R) = A/R^n - B/R^4 - C/R^6$ (12-4-6 model), and $\phi(R) = A/R^n - B/R^4 - C/R^6 + \Delta E^{CT}$ (exchange model), were used to calculate the interatomic potential for all the alkali-ion–rare-gas-atom combinations. A comparison shows that the charge-exchange contribution $\Delta E^{CT} \approx -[2S^2/(1+S^2)]\,(E_A{}^+)^2/(I_B + B/R^4 + C/R^6 - E_A{}^+)$, where $E_A{}^+$ is the electron affinity of the ion, I_B is the ionization potential of the atom, B and C are the coefficients of the polarization interaction terms, and S is the two-center overlap integral between the outer orbitals, enhances the long-range attraction and increases the well depth by about a factor of 5 over the 12-4-6 model. The predictions of the classical rainbow scattering angle for the Cs^+–Ar case are compared for the two models. The difference in the two calculated rainbow angles strongly suggests that low-energy elastic-scattering angular distributions would be a valid test of the assumptions used in the charge-exchange model. (auth)

16668 DISTORTION EFFECTS IN THE ELASTIC SCATTERING OF 100- TO 400-eV ELECTRONS FROM HELIUM. LaBahn, R. W.; Callaway, Joseph (Louisiana State Univ., Baton Rouge). Phys. Rev., 180: 91-6(Apr. 5, 1969).

The elastic scattering of 100- to 400-eV electrons from helium is analyzed by explicit calculations of the scattering phase shifts including the effects of both adiabatic and nonadiabatic distortion of the target atom. The calculations involve numerical solution of the appropriate single-channel scattering equation for low angular momentum states and analytical estimation of the phase shifts for high angular momentum states of the scattering electron. The adiabatic and nonadiabatic distortion effects are represented by the appropriate central potentials derived in earlier works. Results of these calculations are compared with recent experimental data and other calculations. Atomic distortion causes the differential cross section to have a relatively high peak in the forward direction at all energies considered. The nonadiabatic corrections to the adiabatic polarization are required to sharpen and reduce this forward-scattering peak somewhat. As a whole, the inclusion of adiabatic and nonadiabatic distortion gives a rather good description of the differential scattering cross sections throughout the 100- to 400-eV range. (auth)

16669 ELECTRON-IMPACT EXCITATION AND NEGATIVE-ION FORMATION IN NH_3 AND ND_3. Compton, R. N.; Stockdale, J. A.; Reinhardt, P. W. (Oak Ridge National Lab., Tenn.). Phys. Rev., 180: 111-20(Apr. 5, 1969).

Threshold electron-impact excitation of ammonia has been studied using both "trapped electron" and "SF_6 electron-scavenger" techniques. Results from the two excitation studies show four well-defined peaks in the energy range from 6 to 12 eV. The scavenger spectrum exhibits a small peak below the first singlet state, which is analogous to that previously found for H_2O and is tentatively attributed to a triplet state. Also, an intense peak is observed at approximately 17 eV. Dissociative electron-capture cross sections for NH_3 and ND_3 were measured with a total ionization chamber and the various ions contributing to these cross sections were recorded as functions of the electron energy with a TOF mass spectrometer using electron beams with resolution of ~0.1 eV. The total negative-ion cross section for NH_3 (5.74×10^{-18} cm^2) peaking at 5.65 eV is approximately 1.1 times larger than the ND_3 cross section (5.36×10^{-18} cm^2) peaking at 5.86 eV, which is analogous to previous results for water and heavy water. The total ionization cross section for ND_3 peaked at ~0.21 eV higher energy than that for NH_3. This is ascribed to a difference in the zero-point energy for the two molecules. The electron-energy scale determined from Cl^-/HCl in the mass-spectrometer study of the various ion-current peaks (e.g., H^-, NH_2^-, NH^-, etc.) corresponded exactly to that obtained for the cross sections using the 19.31-eV He^- resonance in the total ionization measurements. Accurate measurements of the H^- (D^-) ion kinetic energy as a function of incident electron energy yield a dissociation energy of 4.35 ± 0.15 eV for NH_2-H (or ND_2-D). (auth)

16670 OPTICAL POTENTIAL FOR Li–HBr COLLISIONS AT LOW ENERGIES. Marriott, R.; Micha, David A. (Univ. of California, San Diego, La Jolla). Phys. Rev., 180: 120-3(Apr. 5, 1969).

A molecular optical potential has been used to reproduce the quenching of glory undulations in the total cross section of Li and HBr colliding at relative velocities 10^5 cm/sec $\leq v \leq 3.10^5$ cm/sec. The experimental results over the whole velocity range are well fitted by a r^{-12} law for the imaginary part of the potential. Complex phase shifts, opacity function, and elastic angular distribution have been calculated with this potential. Comparison

with calculations using a real potential shows rainbow and supernumerary rainbow maxima and an increase of intensities at large angles in both cases. The main effect of inelastic transitions is to decrease the scattering intensity at large center-of-mass angles. (auth)

16671 THRESHOLD BEHAVIOR OF THE CROSS SECTION FOR IONIZATION OF He AND Ar BY MONOENERGETIC ELECTRONS. Marchand, P.; Paquet, C.; Marmet, P. (Laval Univ., Quebec). Phys. Rev., 180: 123-32(Apr. 5, 1969).

A new apparatus using crossed-beam techniques with a cylindrical electrostatic electron-velocity selector for the study of ionization-probability curves of gases is described. Results for He^+ and Ar^+ in the first eV above the ionization threshold are given. New computer techniques determine structure and near-threshold behavior. A simple power law yields a good representation of the experimental results for each ion state, with a different power in each case. For He a power law with power 1.16 is found. The results for Ar may be represented by two power laws with powers 1.3 and 1.34, respectively, joining at the energy of the $^2P_{\frac{1}{2}}$ level of Ar^+. (auth)

16672 e–H RESONANCES IN THE 2p EXCITATION CHANNEL. McGowan, J. William; Williams, J. F.; Curley, E. K. (Gulf General Atomic Inc., San Diego, Calif.). Phys. Rev., 180: 132-8(Apr. 5, 1969).

The cross section for the electron-impact excitation of the hydrogen atom to the 2p radiative state has been measured from the threshold (at 10.2 eV) to 50 eV. Primary interest is given to the region between the threshold and the n = 4 level of the hydrogen atom, where several resonances have been identified. An electron-beam resolution of 0.07 eV has been used to study the resonances, while a resolution of 0.18 eV has been used to determine the general behavior of the cross section. Below n = 3 the ^1S resonances appear to agree with the theoretical predictions, but in the case of the higher angular-momentum ^1D resonance, the agreement between present theory and experiment is poor. Balmer-α excitation is discussed. (auth)

16673 STUDY OF Na–O_2 COLLISIONS USING MERGING BEAMS. Neynaber, R. H.; Myers, B. F.; Trujillo, S. M. (General Dynamics/Convair, San Diego, Calif.). Phys. Rev., 180: 139-46(Apr. 5, 1969).

A merging-beams technique was used to study two-body collisions of Na and O_2. In particular, some processes that resulted in positive ions, and negative ions or electrons were investigated. These processes were endothermic and included charge transfer, ionization, and rearrangement. Interaction energies W were varied from threshold, i.e., several electron volts up to 25 eV. In the center-of-mass system and for processes resulting in Na^+ formation, scattering of Na^+ was predominantly at angles less than 90° from the well-defined direction of the reactant Na. For the reaction $Na + O_2 \rightarrow Na^+ + O_2^-$, a very narrow lab energy distribution of Na^+ was observed for which scattering of Na^+ in the center-of-mass system was confined to just a few degrees about the Na direction. For this distribution it was also observed that at least 92% of the excess translational energy of the reactants (i.e., interaction energy minus the endothermicity) was converted into translational energy of the products. Therefore, 8% or less went into internal energy of the products. The cross section for $Na + O_2 \rightarrow Na^+ + O_2^-$ leading to the formation of Na^+ in this narrow energy distribution is called Q_a. At or near threshold (i.e., 4.71 eV), Q_a rises from zero and reaches a maximum at about 8 eV. From absolute measurements, $Q_a \approx 0.05$ Å^2 at W = 10 eV. The existence of NaO^+, first reported by Rol and Entemann, was confirmed in the study of collisions of Na and O_2 leading to rearrangement. (auth)

16674 HYPERFINE EFFECTS ON THE POLARIZATION OF LYMAN-α QUENCH RADIATION. Casalese, J.; Gerjuoy, E. (Univ. of Pittsburgh). Phys. Rev., 180: 327-8(Apr. 5, 1969).

The polarization fraction of radiation from atomic hydrogen prepared in the metastable 2S state and quenched in a small static electric field is calculated in first-order perturbation theory. The calculation includes the electron spin–orbit coupling and the electron–proton spin-coupling interactions. Including the hyperfine effects brings the predicted polarization closer to the observed, but the theoretical results still are slightly outside the experimental error limits. (auth)

16675 PROTON PINBALL MACHINE. Livesey, R. Gordon. Ind. Res., 11: No. 3, 62-4(Mar. 1969).

Proton scattering microscopy is described. This technique is compared to x-ray and electron diffraction and the advantages and disadvantages are pointed out. (M.H.R.)

16676 BOUNDS ON ENERGY LEVELS AND LIFETIMES OF AUTO-IONIZING STATES. Russek, A.; Wu, H. C.; Owens, J. (Univ. of Connecticut, Storrs). Phys. Rev., 180: 6-18(Apr. 5, 1969).

Upper and lower bounds on the energy level of an auto-ionizing state are derived by a method that is a generalization of the Stevenson–Crawford formula for the lower bound on the ground state of a system. These bounds are nonvariational in character, although the lower bound can be used together with a variational upper bound to obtain a narrower gap between upper and lower bound. In addition, an upper bound on the transition rate for the decay of the auto-ionizing state is derived. Although primarily designed to yield information for more than two-electron systems, for which the Hahn, O'Malley, and Spruch version of the Feshbach projection operators cannot explicitly be written down, the methods are here applied to auto-ionizing states in helium below the n = 2 threshold. These bounds are found to be a far more sensitive test of the adequacy of an approximate state than is the conventional energy criterion used in conjunction with the variational approach. (auth)

16677 ANNIHILATION OF POSITRONS IN METALS. Sedov, V. L. (Moscow State Univ.). Usp. Fiz. Nauk, 94: 417-38(Mar. 1968). (In Russian).

A brief review is given of experimental and theoretical work on the behavior and annihilation of positrons in solids. Positron annihilation is related to various laws of conservation of physical magnitudes only by properties of valent electrons and thermalized positrons. The following are discussed: possibility of positron formation in metals; half life of positrons in metals; angular correlation of annihilation of γ-quantum pairs; effective positron mass in metals; polarized positron annihilation in ferromagnetic metals; and positron annihilation with n photon formation in metals. 82 references. (R.V.J.)

16678 ATOMIC COLLISIONS AT LOW ENERGY. Pahl, M. (Univ., Innsbruck). Acta Phys. Austr., 27: 50-76(1968). (In German).

In the present review the term atomic collisions includes only the following groups of processes: (electron collisions with neutral atoms or molecules, collision processes between ions and neutral products, ionizing collisions between neutral reactants in which at least one is excited, and photoexcitation and photoionization). The most important new refinements of experimental methods for the study of these atomic collisions are summarized. The capacity of these methods is illustrated by individual examples. (J.S.R.)

16679 $L_1N_{IV,V}$ AND L_1O_I TRANSITIONS IN Ho. Nigam, A. N.; Kapoor, Q. S. (Univ. of Rajasthan, Jaipur, India). Physica, 38: 633-4(June 5, 1968).

The γ region of the L-emission spectrum of holmium was investigated, using a 40-cm curved-mica-crystal spectrograph of the Cauchois type. The quadrupole transition $L_1N_{IV,V}(\gamma_{11})$ at λ = 1341.2 X.U. and the forbidden transition L_1O_I at λ = 1324.9 X.U. have been reported for the first time. (auth)

16680 EXCITATION FUNCTION OF THE N_2^+ MEINEL BAND BY ELECTRON IMPACT. Srivastava, B. N.; Mirza, I. M. (Univ. of Alaska, College). Can. J. Phys., 47: 475-6(Feb. 15, 1969).

Excitation cross sections of the N_2^+ Meinel bands by electron impact have been determined and are compared with the theoretical values obtained from the Franck–Condon factors of the excitation. (auth)

16681 VARIATIONAL CALCULATION OF THE PROBABILITIES OF SINGLET–TRIPLET TRANSITIONS IN THE HELIUM ATOM. Yurev, M. S. Opt. Spectrosc. (USSR) (Engl. Transl.), 25: 157-8(Aug. 1968).

Translated from Opt. Spektrosk., 25: 295-7(Aug. 1968).

Calculation of the probabilities of certain singlet–triplet transition in the helium atom is attempted, using a variational procedure for the probability of forbidden transitions. As the perturbation giving rise to the appearance of singlet–triplet transitions, the Breit correction is chosen, which incorporates accurate relativistic corrections of order α^2, where α is the fine structure constant. (M.H.R.)

Cosmic Radiation

Refer also to abstracts 16603, 16617, 16619, 16620, 16930, and 16952.

16682 (INR–944) DENSITY-RATIO METHOD FOR LOCALIZING THE AXIS OF EXTENSIVE AIR SHOWER. Jatczak, Jerzy (Institute of Nuclear Research, Warsaw (Poland)). 1968. 34p. Dep.

A method was developed for localizing the axes of individual showers by measuring the ratios of the densities of charged par-

ticles in the shower. With the assumption that the age parameter s = 1.25, nomograms were drawn for localizing the axes of showers in a 75-meter circle. (auth)

16683 (N-68-33370) EXPERIMENTAL TESTS OF THE SUPERNOVAE ORIGIN OF COSMIC RAYS. Fichtel, C. E.; Ogelman, H. B. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Sept. 1968. 21p. (NASA-TN-D-4732). CFSTI.

The general problem of supernovae explosions as a possible origin of cosmic rays is reviewed. The shock wave theory of Colgate et al., the only detailed model of supernovae explosions to date, predicts a short, intense high-energy γ-ray pulse associated with the explosion and cosmic-ray acceleration. Two experimental tests capable of detecting the predicted initial explosion are suggested. One is a spark-chamber γ-ray telescope which, when flown above the Earth's atmosphere, could detect pulses of protons above 30 MeV. The other experiment, which is ground-based, could detect the fluorescence produced in the atmosphere by the electromagnetic pulse radiated by the supernova during its explosion. (auth) (STAR)

16684 SUMMARY OF EXPERIMENTAL VERIFICATION OF THE FLUX AND ENERGY SPECTRUM OF SECONDARY ELECTRONS AT HIGH ALTITUDES IN THE ATMOSPHERE. Verma, Satya Dev (Louisiana State Univ., Baton Rouge). Can. J. Phys., 47: 513-4(Mar. 1, 1969).

A brief summary of the measurement of the flux and energy spectrum of secondary electrons at balloon altitude over Fort Churchill is given. These measurements are compared with two calculations, one by Perola and Scarsi and the other by the author. A correction is made to an error of Beedle and Webber in plotting the results of the author's calculations. (auth) (Canada)

16685 COSMIC-RAY NEGATRON AND POSITRON SPECTRA BETWEEN 12 AND 220 MeV. Beuermann, K. P.; Rice, C. J.; Stone, E. C.; Vogt, R. E. (California Inst. of Tech., Pasadena). Phys. Rev. Lett., 22: 412-15(Mar. 3, 1969).

The interplanetary negatron and positron spectra from 12 to 220 MeV have been determined with a balloon-borne magnetic spectrometer. The observed charge ratio $e^+/(e^+ + e^-) \approx 0.3$ indicates that the flux most likely consists of a mixture of primary negatrons and interstellar secondary negatrons and positrons. An absolute solar modulation of the interstellar positron flux which decreases with decreasing magnetic rigidity below about 80 MV is deduced. (auth)

16686 COSMIC X-RAYS, γ-RAYS, AND ELECTRONS. Daniel, R. R. (Tata Inst. of Fundamental Research, Bombay). Symp. Theor. Phys. Math., 6: 111-24(1968).

The various processes that can give rise to electrons, x-rays, and γ rays are described. They include direct acceleration, secondary electron production, bremsstrahlung loss, synchrotron loss, inverse Compton effect, and π^0 decay. The astrophysical significance of the cosmic-ray electron component, x rays, and γ rays is discussed. (W.D.M.)

16687 PRONOUNCED DIURNAL VARIATION IN COSMIC-RAY INTENSITY. Mathews, T.; Venkatesan, D.; Wilson, B. G. (Univ. of Calgary, Alberta). J. Geophys. Res., 74: 1218-29 (Mar. 1, 1969).

Enhanced diurnal variations during February 1-6, 1967; April 5-14, 1967; and February 22-28, 1968, were examined by use of data from several super neutron monitors. It is found that, during these days, cosmic-ray intensity in a direction 40 to 70° west of the Sun-Earth line was lower with respect to other directions, in particular the polar and antigardenhose directions. This anisotropy, which resulted from a reduced intensity in the gardenhose direction in the ecliptic plane, suggests that the entire diurnal variation observed in cosmic-ray intensity cannot be attributed to a simple mechanism involving the corotation of cosmic-ray gas, with the interplanetary field. Corotation of cosmic-ray gas implies an enhancement of intensity from a direction roughly 90° east of the Sun-Earth line (1800 hr direction). Highly variable north-south asymmetries were also present during these periods. These anisotropies occurred without accompanying geomagnetic disturbances or Forbush decreases indicating that they were not due to solar activity on the visible side of the Sun. (auth)

Direct Energy Conversion

16688 (N-68-31407) SOLAR ENERGY THERMIONIC (SET) PROGRAM. Final Report, Task 1. Pantazelos, P. G.; Merra, S.; Brosens, P.; Gunther, B. (Thermo Electron Engineering Corp., Waltham, Mass.). Mar. 1968. Contracts NAS7-100; JPL-950671. 276p. (NASA-CR-96013; TE-4034-73-67). CFSTI.

For Jet Propulsion Lab., Pasadena, Calif.

Thermionic converters incorporating rhenium emitters were designed to emphasize power output and mechanical ease of attachment to the solar thermionic generator structure. Three prototype converters were designed; and the third, which used a pressure bonded emitter, was used in the generator. Generator support structure shielding and electron bombardment heater were designed and constructed concurrently with the converter development program. Because the converter was designed to achieve maximum power output at 0.7 volt, a large heavy radiator was required to reject the necessary heat. Since generator calculations indicated optimum efficiency at 0.9 volt, this diode voltage was optimized in radiator design. A thin radiation shield between radiator and reservoir improved cesium reservoir temperature distribution. A four-converter generator, JG-3, was designed with thermal shielding between the diodes and the generator blocks. The final electron-bombardment gun design had individual filaments for each of the diodes. (STAR)

16689 (N-68-31488) THERMIONIC RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report. Jacobson, D. L.; Hamerdinger, R.; Campbell, A. (Electro-Optical Systems, Inc., Pasadena, Calif.). July 12, 1968. Contracts NAS7-100; JPL-952217. 71p. (NASA-CR-95979; EOS-4006-Q-1; QPR-1). CFSTI.

For Jet Propulsion Lab., Pasadena, Calif.

Single crystal molybdenum and rhenium electrodes were considered for yielding a low work function collector surface in thermionic converters. Vacuum emission vehicle determinations of the effective and Richardson work functions were made, and electrode surfaces using a thermionic emission microscope were examined. Both x-ray and metallographic analyses were made, and a vapor-deposited rhenium variable parameter test vehicle was considered for studying minimum work function and optimized power output of these same electrodes. Converter design and thermal mockups are described for a 1700 to 1800°K cylinder converter; and details are included of the emitter subassembly, emitter support structure, collector-radiator structure, prefabricated metal-to-ceramic seals, and cesium reservoir. (STAR)

16690 (N-68-31490) SOLAR THERMIONIC GENERATOR DEVELOPMENT. Quarterly Report, March 1-May 31, 1968. (Thermo Electron Engineering Corp., Waltham, Mass.). Contracts NAS7-100; JPL-951263. 32p. (NASA-CR-95980; TE-4055-176-68; QR-10). CFSTI.

For Jet Propulsion Lab., Pasadena, Calif.

The fabrication and test of converter T-209 were completed. This model was the second to incorporate a collector-radiator heat pipe structure. The heat pipe design was changed substantially in order to remedy a choked heat pipe vapor flow condition observed in the previous model T-208, and subsequent tests showed that this objective was reached. Converter T-209 equalled the highest output observed from any of the rhenium-emitter and rhenium-collector converters fabricated; however, during tests at high heat inputs, the output was found to deteriorate. This was the first instance of degradation experienced, and it appears that it was caused by a leak of sodium vapor from the heat pipe into the converter envelope, which resulted in an increase of the collector work function of 0.17 eV. The mechanism responsible for the sodium leak is not known. The layout of the 16-converter generator was completed, and the design is now ready for the preparation of detailed drawings. (auth) (STAR)

16691 (N-68-32103) CASCADED THERMOELECTRIC TEST GENERATOR, PHASE 1. Quarterly Progress Report, February 23-May 31, 1968. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Contracts NAS7-100; JPL-952196. 11p. (NASA-CR-95996; WANL-PR(DDD)-001). CFSTI.

For Jet Propulsion Lab., Pasadena, Calif.

The design and fabrication of a cascaded SiGe/PbTe thermoelectric test generator are covered. This effort is being performed in two phases: Phase I consists of a detailed design and analysis of the cascaded test generator, and Phase II consists of the fabrication and checkout testing of the system. The work reported herein covers the initial design of the cascaded test generator under Phase I. The system concept, preliminary system design, and performance estimates are presented. (auth) (STAR)

16692 (N-68-32185) THERMIONIC RESEARCH AND DEVELOPMENT PROGRAM. Final Report, July 15, 1966-January 15, 1968. Campbell, A. E.; Jacobson, D. L. (Electro-Optical Systems, Inc., Pasadena, Calif.). Mar. 1, 1968. Contract NAS7-514. 146p. (NASA-CR-96148; EOS-7118). CFSTI.

An overview of a research program designed to improve the

output performance of low emitter temperature, cesium-vapor thermionic converters is presented. Task I involved the design and fabrication of two ultrahigh vacuum instruments in which electron emission (vacuum), surface uniformity, secondary recrystallization, and electrode preparation techniques of planar emitters could be measured or evaluated; and also involved a limited metallurgical investigation of crystallographic orientation, material purity and density, and surface structure. Task II comprised the fabrication and operation of variable parameter test vehicles for the purpose of measuring cesium vapor converter output performance at low emitter temperatures. Two variable parameter test vehicles were operated, and parametric studies were conducted employing a vapor deposited rhenium emitter/vapor deposited rhenium collector selected from Task I, and a polycrystalline rhenium emitter/molybdenum collector. Two planar converters were fabricated and tested to demonstrate performance of the vapor deposited rhenium system and to correlate research data from the test vehicles. Task III encompasses the interpretation of experimental results, particularly regarding the variable parameter test vehicle operation. (STAR)

16693 (N-68-32968) ELECTRON-BOMBARDMENT FILAMENT DESIGNS FOR HEATING CYLINDRICAL THERMIONIC CONVERTERS. Cipollone, Peter (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Aug. 1968. 20p. (NASA-TM-X-1630). CFSTI.

The effect of axially varying the pitch of helical electron-bombardment heaters on the axial distribution of radial heat flux to an internally heated hollow cylinder was investigated, the cylinder simulating the electron-emitting electrode of a thermionic converter. Measured axial distributions of temperature and corresponding calculated heat fluxes are presented for a series of five variable-pitch filaments and for mean emitter-surface temperatures of 1778 to 2038°K. These results are compared to similar data obtained with a uniform-pitch filament. (auth) (STAR)

16694 (NYO-3886-2) IMPROVED COMPATIBLE MATERIALS FOR THERMOELECTRIC POWER GENERATION. Final Report. Dismukes, J. P.; Kudman, I.; Moss, H. I. (Radio Corp. of America, Princeton, N. J. RCA Labs.). Nov. 1968. Contract AT(30-1)-3886. 98p. Dep. CFSTI.

Exploration of new alloys was based on the RCA innovation that dilute alloy systems can have superior properties to those of more concentrated alloys. This principle was successfully demonstrated by showing that n-type 95% PbTe–5% GeTe alloys exhibited a figure-of-merit 40% greater than n-type PbTe (TEGS-3N). The n-type PbTe–GeTe was optimized with respect to alloy composition and dopant concentration, and these alloys were shown to exhibit no inherent instabilities. The general parameters required for hot-pressing n-type material were established, and hot-pressing was shown to provide improved mechanical strength over melt-grown material. A p-type alloy, 95% PbTe–5% PbSe, was discovered, and shown to have a figure-of-merit 30% greater at elevated temperatures than p-type PbTe (TEGS-2P). Efforts were concentrated on carrying out a comprehensive study of the mechanical properties of the hot-pressed material, continued monitoring of the life tests, and continued development of hot-pressing techniques. Concerning mechanical strength, it was shown that the major difference between n- and p-type material is the greater ductility of the n-type material at room temperature. At elevated temperatures, the compressive strength of commercial 2P material drops sharply, which explains its inferior mechanical properties to commercial 3P alloys. The p-type 95% PbTe–5% PbSe alloys developed were shown to have superior mechanical properties to commercial 3P alloys over the entire temperature range. With respect to life test behavior, an improved procedure involving a final annealing step was devised for melt-grown materials. As a result, both n- and p-type melt-grown RCA alloys exhibit excellent stability during isothermal high temperature annealing. However, the hot-pressed materials have exhibited excessive changes in resistivity on life test. This problem is ascribed to oxygen contamination and should be improved by the modified hot-pressing procedure described below. Early results on hot-pressing appeared very promising, since both n- and p-type materials were prepared with properties within 10% of the optimum Seebeck coefficient (Q) and electrical resistivity (ρ) values. However, the n-type properties could not be reproduced. An improved hot-pressing procedure was devised in which the starting powders are given a high temperature anneal (~700°C) in hydrogen directly prior to hot pressing. As a result, the Q and ρ values of the starting material have been accurately reproduced in the hot-pressed samples. Several alloy systems were examined and rejected either because they exhibited no improvement in the figure-of-merit, had poor mechanical properties, or were unstable. Those include p-type PbTe–GeTe (both PbTe-rich and GeTe-rich), PbTe–GeTe–PbSe, PbTe–ZnSe, PbTe–PbSe–ZnSe, and GeTe–PbTe–Bi_2Te_3. The result is the development of both n- and p-type alloys with a greatly improved thermoelectric figure-of-merit, and improved mechanical properties. No inherent instabilities have been encountered with these alloys. Using these improved alloys, the calculated theoretical efficiency of power generation is about 11% for a thermocouple operating from 250 to 1000°F (125°C to 525°C), which is a 17% improvement over present commercial thermoelectric materials. (auth) (TSS)

16695 IMPROVEMENTS IN THERMOELECTRIC GENERATORS. Debiesse, Jean; Klein, Siegfried (to Commissariat a l'Energie Atomique). British Patent 1,143,291. Feb. 19, 1969. Priority date May 19, 1965, France.

A thermoelectric generator consisting of n-type semiconductor elements and p-type semiconductor elements stacked alternately against each other is described. Detailed discussions of the individual components are given. (M.O.W.)

16696 IMPROVEMENTS RELATING TO THERMO-ELECTRIC CONVERTER TUBES FOR GENERATING ELECTRIC POWER FROM HEAT. Clapp, Malcolm Donald (to Fairey Engineering Ltd.). British Patent 1,143,945. Feb. 26, 1969. Filed May 13, 1965.

The system described comprises a gas-filled thermionic diode having a heated cathode emitter and a collector connected to output terminals for connection in a load circuit, and having an auxiliary positive electrode arranged to cooperate with the cathode to produce an auxiliary gas discharge in the diode, whose positive ions serve to neutralize the space charge. The emitter and auxiliary electrode are connected in a relaxation RC oscillator circuit, by means of which the auxiliary gas discharge is cyclically triggered and extinguished as a train of short current pulses, whereby the emitter–collector current of the diode is modulated to a saw-tooth wave form whose frequency is determined by the time constants of the oscillator, the wave form being determined by the respective rates of buildup and decay of the ionization produced by the auxiliary discharge pulses. The cathode emitter is heated by a radioactive isotope contained within the diode housing. No active external modulation system is required. (UK)

16697 A METHOD OF AND APPARATUS FOR HEATING A FLUID BY MEANS OF AN AUXILIARY FLUID AT HIGH PRESSURE. Brocher, Eric British Patent 1,132,324. Oct. 30, 1968. Priority date July 27, 1965, Switzerland.

The invention relates to a method and apparatus for heating a fluid by means of a high-pressure auxiliary fluid, permitting temperatures to be attained up to several times those from conventional heat sources. The fluid to be heated and the auxiliary fluid at a higher pressure are introduced alternately and periodically into at least one shock tube which is blocked off cyclically so as to effect a compression by shock wave. (M.O.W.)

16698 TWO-DIMENSIONAL INVESTIGATIONS OF MHD GENERATORS WITH CONSIDERATION OF THE HALL EFFECT. Bresgen, Helmut (Univ., Innsbruck). Acta Phys. Austr., 27: 248-54(1968). (In German).

A method for the comprehension of the physical processes in an MHD generator is developed. It consists of a Fourier series development with coefficients determined over terminal conditions, and leads to a limitless system of equations. (tr-auth)

16699 ELEKTRONISCHE ENERGIEWANDLER. (Electronic Energy Converters). Bloss, Werner. Physik und Technik, Band 8. Stuttgart, Wissenschaftliche Verlagsgesellschaft mbH, 1968. 165p. DM 44,--.

The modern unconventional methods for the direct conversion of heat into electrical energy are described. After a brief introduction into the thermodynamics of energy conversion, the thermoelectrical, thermionic, and photoelectrical converters are described. Both the thermodynamic theory and the calculation methods for the optimization of the energy converter as well as the corresponding materials, the technological problems, and the various applications are considered. The magnetohydrodynamic generators, the electrohydrodynamic generators, and the dielectrical and ferromagnetic energy converters were also described. (tr-auth)

Fluid Physics

Refer also to abstracts 16610, 16832, and 16892.

16700 POYNTING'S THEOREM FOR A MOVING CONDUCTOR MEDIUM. Merches, I. (New York Univ.). Phys. Lett., 28A: 515-16(Jan. 13, 1969).

By using the method of statistical averaging of Boltzmann's

equation, the law of conservation of electromagnetic energy for a moving conductor medium is found. (auth)

16701 FLOW OF MERCURY IN A ROTATING TORUS WITH INDUCTIVE TRANSMISSION OF FORCES AFFECTED BY AN AZIMUTHAL MAGNETIC FIELD. Kuschel, G. Pr. Inst. Masz. Przeply., No. 34, 117-27(1967). (In German).

The following theoretical and experimental investigations are reported: (i) the examination of an induction pump in a curved channel; (ii) flow investigation in a rotating torus; and (iii) examination of the effect of an azimuthal magnetic field on the flow in a rotating torus. The flow resistance is determined as a function of the Reynolds number and the speed of rotation. The results of measurements of flow resistances due to the locally nonuniform, constant magnetic field are also set forth. (App. Mech. Rev.)

16702 THEORY OF LINEARIZED MAGNETOFLUIDMECHANICS. Sung, K. S. J. Korean Phys. Soc., 1: 17-33(Mar. 1968).

The steady two-dimensional flow of a compressible, conducting fluid past a wavy wall or a thin symmetrical airfoil is studied for the case where the undisturbed, uniform magnetic field is oriented either perpendicular or parallel to the undisturbed uniform stream. Exact solutions of the linearized magnetogasdynamic equations are obtained for arbitrary values of Mach number M, Alfven number A, and magnetic Reynolds number R_m for wavy walls of various forms. The solutions for a thin symmetrical airfoil are obtained in terms of the Fourier transforms, the inversions of which are carried out only for the case of a perfectly conducting fluid. Included in the solutions are the effects on the flow fields of a system of magnetic dipoles and currents placed in the bodies (airfoils and wavy walls). For sub-fast-wave flow with infinite R_m and crossed undisturbed fields, the present theory gives a negative drag for certain current systems in the body. The slow and fast waves of magnetogasdynamics at infinite R_m are generalized to damped waves for arbitrary R_m. They become Mach waves in in the limits $R_m \to 0$ or $A \to \infty$. When the undisturbed fields V_0 and B_0 are aligned, the upstream facing wave and a magnetic wake (or magnetic boundary layer) facing either downstream or upstream are recognized in the compressible flows past wavy walls for large R_m. A reversed flow theorem for the upstream wake and the current-free classical ideal flows are developed for arbitrary R_m. Lastly, the flow past wavy wall with finite thickness is obtained where the fluids above and below the wall may be different, i.e., the free streams directions, Mach Number, magnetic Reynolds numbers, etc., for the flows above and below the wall may be different. (auth)

Geophysics (Upper Atmosphere)

Refer also to abstracts 16602, 16604, and 16623.

16703 (AD-672834) RESEARCH IN IONOSPHERIC PHYSICS. Summary Technical Report No. 12, August 1, 1967-January 31, 1968. Drake, F. D. (Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research). Jan. 31, 1968. Contract F44620-67-C-0066. 147p. (CRSR-72; AFOSR-68-1629; AD-659439). CFSTI.

The report includes discussion of work at the Arecibo Ionospheric Observatory, brief discussions of the research programs, a list of publications and personnel, and a table summarizing the results of experiments. (auth) (USGRDR)

16704 (AD-672848) PROGRAM OF GROUND BASED AURORAL OBSERVATIONS COORDINATED WITH SIMULTANEOUS SATELLITE MEASUREMENTS. Final Report, October 1, 1964-December 31, 1966. Romick, G. J.; Hook, J. L. (Alaska Univ., College. Geophysical Inst.). Nov. 1967. Contract Nonr-3010 (06). 71p. CFSTI.

In order to participate in a coordinated satellite and ground-based observation program, the Geophysical Institute of the University of Alaska equipped optical and radio ground stations along a geomagnetic meridian in the northern auroral zone. The polar orbiting satellite, instrumented with a multitude of electron and proton particle detectors was in orbit for three days from November 9 to 11, 1965. The satellite had an inclination of 94° with an initial apogee of 300 km and perigee of 160 km. The satellite was Earth-oriented and was held to about 1° attitude during its life. The period during which the satellite was in orbit was magnetically very quiet. Usable coordinated data were obtained during the first day. After that, the auroras observed from the only clear station (College) were too far north to be quantitatively useful. A detailed analysis of the data obtained on the first day has provided basic data on the auroral hydrogen arc. (auth) (USGRDR)

16705 (AD-673794) IONOSPHERIC RESEARCH IN SUPPORT OF ATMOSPHERIC IONIZATION EFFECTS. Air Force Surveys in Geophysics No. 205. Gassmann, George J. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). June 1968. 59p. (AFCRL-68-0318). CFSTI.

For the specific goal to control or predict man-made ionization effects, the Defense Department has stimulated research in some areas and particularly in ionospheric physics. The results are reviewed with the implication that most of them are significant only within the larger pool of knowledge being produced by basic research. The review covers recent results gained by means of rockets and satellites on various atmospheric parameters and on the various particle inputs. Further, it reports on conjugate phenomena, on geographical features of particle influx and of electric fields and on progress in radio propagation measuring techniques. Finally, it reviews the observed effects on the ionosphere during the coordinated November 12, 1966 solar eclipse expedition. (auth) (USGRDR)

16706 (N-68-31337) MEASUREMENTS OF ELECTRON COOLING RATES IN THE MIDLATITUDE AND AURORAL ZONE THERMOSPHERE. Brace, L. H.; Mayr, H. G.; Carignan, G. R. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). June 1968. 34p. (NASA-TM-X-63291; X-621-68-211). CFSTI.

Two day-night pairs of Thermosphere Probe rockets, launched at Wallops Island, Virginia in March of 1965 and at Churchill, Manitoba in November of 1965, have provided altitude profiles of electron temperature and concentration at midday and midnight. Altitude profiles on N_2 measured on the same four flights have in addition provided neutral gas temperature profiles. These data are employed to calculate electron cooling rate profiles, and these in turn are interpreted in terms of ionospheric heat sources. The daytime electron heat source for the F region, at both middle latitudes ($L = 2.9$) and in the auroral zone ($L \approx 8$), appears consistent with solar ultraviolet heating. The nighttime F region, however, appears to be heated by downward conduction from the protonosphere at middle latitudes and by particle heating in the auroral zone. The source of electron heating for the E region both day and night and at both locations cannot be explained by direct solar heating. This may be produced by neutral winds, electric currents, an unknown chemical reaction or, as Walker has suggested, selective heating of the electrons by excited N_2 having lifetimes in the E region of the order of a day. (auth) (STAR)

16707 (N-68-31351) FINE STRUCTURE IN THE ENERGY SPECTRUM OF LOW-ENERGY AURORAL ELECTRONS. Evans, D. S. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). July 1968. 21p. (NASA-TM-X-63298; X-612-68-291). CFSTI.

Several auroral electron data collection events and measurement techniques are reviewed. Data on low energy auroral particles are analyzed. The resulting electron energy spectra are characterized as having structure with peaks. Two types of explanation are proposed to account for this phenomenon; it is due to an energy selection process, or it is a direct consequence of the energizing process. Interpretation and discussion of the collected data in the framework of these propositions strongly indicate that electrostatic fields have played a role in the acceleration process although alternatives cannot be eliminated. Several plots of the electron energy spectra are included. (STAR)

16708 (N-68-31888) DIURNAL VARIATION OF THE ION TEMPERATURE. Mahajan, K. K. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). June 1968. 19p. (NASA-TM-X-63297; X-621-68-11). CFSTI.

Results on the diurnal variation of the ion temperature, obtained from the Thomson scatter spectra, in the height range 250 to 475 km are presented. At 250 km where the ion temperature (T_i) is expected to be nearly equal to the neutral temperature (T_n), T_i is generally observed to show diurnal maximum at 16 hr L. T. and diurnal minimum at 4 hr L. T., with no appreciable change in these times with solar activity. The average day to night T_i ratio at 250 km is found to be 1.45. These results are in apparent conflict with the satellite drag analysis in which T_n is found to have a diurnal maximum at 14 hr L. T. and day to night temperature ratio around 1.30. At 475 km where T_i is significantly above T_n, the diurnal behavior of T_i is observed to be different on different days. The day-to-day and hour-to-hour variations in T_i at this height are found to be due to the changes in the electron density and electron temperature and seem consistent in terms of an energy budget that includes heating of the ion gas by the hotter thermal electrons and cooling by the neutral atmosphere. (auth) (STAR)

16709 (N-68-32908) SOLAR PROTONS (135 TO 1650 keV) AFTER THE FLARE OF JULY 7, 1966 OBSERVED IN THE MAGNETOTAIL AND MAGNETOSHEATH. Konradi, Andrei (National Aeronautics and Space Administration, Greenbelt, Md.

Goddard Space Flight Center). Aug. 1968. 23p. (NASA-TM-X-63316; X-612-68-321). CFSTI.

Protons with energies E > 135 keV were observed in the tail of the magnetosphere following the flare of July 7, 1966. These protons have an isotropic pitch-angle distribution. The maximum intensity of the protons reached $\approx 1.2 \times 10^4$ $(cm^2\ sec\ ster)^{-1}$ for particles with P > 15 MV between 1000 and 1100 UT and 1400 and 1500 UT July 8, 1966. The energy spectrum of the protons expressed as an exponential in momentum indicates a monotonic softening, the characteristic rigidity changing from about 50 to 10 MV. An hour long excursion of the satellite into the magnetosheath during the peak of the proton flux showed that the proton intensity is lower in the magnetosheath than in the magnetosphere by a factor of two. The observed pitch-angle distribution is flat in both regions. (auth) (STAR)

16710 (N-68-33197) IONOSPHERIC COMPOSITION MEASUREMENTS WITH AN RF IMPEDANCE PROBE. Miller, E. K.; Schulte, H. F. Jr. (Michigan Univ., Ann Arbor. High Altitude Engineering Lab.). May 1968. Contract NASR-54(05). 56p. (NASA-CR-96373). CFSTI.

Consideration is given to extending various methods used for determining electron number density in the ionosphere to ion composition measurements. A technique involving the impedance of an antenna operated in a frequency range on the order of the ion cyclotron frequency to the electron cyclotron frequency appears promising. Theoretical impedance results for some idealized combinations of ions as well as typical ion mixtures encountered in the ionosphere illustrate application of the technique. The advantages and limitations of the impedance probe are discussed. (auth)(STAR)

16711 (N-68-33198) IONOSPHERIC CHARACTERISTICS FROM ALTITUDE VARIATIONS OF POSITIVE ION DENSITIES AT NIGHT. Scientific Report. Ghosh, S. N. (Michigan Univ., Ann Arbor. High Altitude Engineering Lab.). Mar. 1968. Contract NASr-54(05). 23p. (NASA-CR-96379). CFSTI.

Altitude variations of different types of positive ions in the ionosphere at night obtained from rocketborne experiments, have been utilized to obtain ionospheric characteristics. Major nighttime ionic processes and rate coefficients of certain reactions involving positive ion–neutral atoms or molecules are obtained. Lifetimes and effective recombination coefficients of positive ions at night are also obtained. It is further shown that at night the ionosphere is not in equilibrium. Only at localized regions, there is equilibrium between the production and loss rates. (auth) (STAR)

16712 (N-68-33229) SOUNDING ROCKET MEASUREMENTS OF ION COMPOSITION AND CHARGED PARTICLE TEMPERATURES IN THE TOPSIDE IONOSPHERE. Maier, E. J. R. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Aug. 1968. 26p. (NASA-TM-X-63315; X-615-68-316). CFSTI.

The concentrations of H^+, He^+, and $(O^+ + N^+)$ were measured as a function of altitude from 300 km to 600 km by means of an ion mass spectrometer. The major constituent was found to be O^+ over the entire altitude range, decreasing from >99% of the total ion density at 300 km to 88% at 600 km. Hydrogen and helium ions were present as minor constituents increasing with altitude to 11% and ≈1% respectively at 600 km. At the same time, the electron and total ion densities and temperature were measured and compared by means of retarding-potential analyzers. The ion temperature was found to increase with an altitude gradient of 1.7°/km from 1100° at 300 km to 1600° at 600 km. Electron temperatures were found to increase rather sharply in the 400 to 500 km altitude from the fairly typical value of 2500° to the very high value of 3500° at 600 km. (auth)(STAR)

16713 (N-68-33267) THE DYNAMIC COUPLING BETWEEN F2-REGION AND PROTONOSPHERE. Mayr, H. G. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). July 1968. 22p. (NASA-TM-X-63310; X-621-68-300). CFSTI.

The time-dependent continuity equations for H^+ and O^+ are solved by means of a perturbation method. A solution for the diurnal variation of these ion species is presented to illustrate the dynamic effects of the coupling between F2 region and protonosphere. The variability of the ion composition transition level is discussed in view of the observed ion trough at high latitudes, and from this, evidence is found for a continuous depletion of protons there. (auth) (STAR)

16714 (N-68-34059) TEMPORAL VARIATIONS OF THE 100 keV TO 1700 keV TRAPPED PROTONS OBSERVED ON SATELLITE EXPLORER 26 DURING FIRST HALF OF 1965. Soraas, F.; Davis, L. R. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Aug. 1968. 52p. (NASA-TM-X-63320; X-612-68-328). CFSTI.

The temporal behavior of 100-keV geomagnetically trapped protons in the region 2 to 5.5 R_E for the period 29 January through June 29, 1965 was determined using data from a scintillation detector on Explorer 26. The results exhibit both adiabatic changes which vary directly with the magnetic field (Dst) and nonadiabatic changes which do not track the field. The adiabatic variations, which result from slow changes in fields during which all three adiabatic invariants are conserved, can be removed by transforming the measurements from the time-dependent field to a reference field. The transformation was computed for protons mirroring on the equator using a disturbance field, $B(t,L) = C \cdot Dst(t) \cdot f(L)$ where C is a constant (≈0.7) that corrects for the induction field of the conducting Earth, t is the time of observation and f(L) is the radial dependence for a model ring current field. The transformation reduces the regression coefficients of proton intensity on Dst by a factor of 5 or more out to L = 4.5. The transformed data clearly show nonadiabatic variations. The protons underwent rapid changes during magnetic storms. (auth) (STAR)

16715 (N-68-34633) GEOMAGNETIC TAIL. Ness, Norman F. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Sept. 1968. 63p. (NASA-TM-X-63330; X-616-68-345). CFSTI.

An overview is presented on the experimental investigations of the Earth's magnetic tail and imbedded neutral sheet which established its permanent existence as an extension of the magnetosphere with lines of force closely paralleling the Earth–Sun line. Physical properties and dynamics of the geomagnetic tail are defined, and a figure is included to depict both the geometry of the tail and the Earth's bow shock in cislunar space, as well as the orbits of the satellites used in the experiments. Among the data reported are: (1) The plasma sheet surrounding the neutral sheet appears to be thicker in the center of the tail, flaring to approximately twice that near the dusk and dawn magnetopause boundaries. (2) The tail is still well-defined out to radial distances of 80 R_E although at distances of 500 and 1000 R_E it appears to have broken up into separate filaments. (3) Multiple correlation and regression analysis show that the field magnitude decreases from approximately 16 gamma at 20 R_E to 7 gammas at 80 R_E. (auth) (STAR)

16716 NUMERICAL STUDY ON FINITE-AMPLITUDE HYDROMAGNETIC WAVES IN A MODEL MAGNETOSPHERE WITH THE DENSITY PLATEAU. Okuzawa, Takashi (Tokyo Univ.). Inst. Space Aeronaut. Sci., Univ. Tokyo, Rep., 32: 215-31(Dec. 1967).

Results are given of numerical experiments on finite-amplitude hydromagnetic (HM) waves to determine their gross behavior in a model magnetosphere including the density plateau. One-dimensional HM equations are integrated by a finite-difference scheme in which physical dissipation is imitated by the Neumann–Richtmyer artificial viscosity. From the numerical solutions obtained, it is suggested that oscillatory motion of the magnetopause can occur even when the solar-wind pressure increases monotonically. This feature also suggests a means of energy supply from the sun to the cavity-resonance system of the Earth's magnetic field. (IAA)

16717 POLAR AURORA SPECTRUM. Rossbach, A. Z. Geophys., 34: 535-53(Dec. 1968). (In German).

Incident energetic particles cause a glow in high latitudes called polar aurora. Spectroscopic analysis shows a system of lines and bands originating from atomic oxygen and molecular nitrogen. Intensity and color of the luminescent features are due to the energy spectrum of the incoming electrons and protons and the magnetic activity. Special phenomena at the hydrogen zone and polar cap absorption are described. The dependence of the emission height on the interaction of energetic particles with gaseous molecules of the polar atmosphere is discussed. The imperfect knowledge of the spatial and temporal distribution of the auroral particles allows at present only an incomplete understanding of the observed auroral emission. (auth)

16718 A THEORY OF AURORAS AND THE RING CURRENT. Piddington, J. H. (Commonwealth Scientific and Industrial Research Organization, Sydney). J. Atmos. Terrest. Phys., 29: 87-105(1967). (RPP-1000).

An earlier model of the distant geomagnetic field had a long tail into which field lines were driven by frictional interaction between the co-rotating magnetosphere and the solar plasma. Observational data are interpreted here to show that the total magnetic flux in the tail varies by a factor of two or more. These data comprise direct measurements of the tail field strength, measurements of the high-latitude boundary of trapped electrons, observations of large expansions and contractions of the 'auroral oval' during

magnetic storms, and finally the complex patterns of polar ionospheric electric currents and auroral drift motions. Change in tail flux requires flow of field lines to and from the tail and to the latter are attributed visual auroras, the geomagnetic ring current and some changing patterns of the ionospheric current system. Field lines in the tail reconnect across a 'neutral sheet,' converting magnetic to particle kinetic energy E ≳ 1 keV; the lines then contract elastically towards the Earth. Particles with small pitch angles are further accelerated mainly along the field lines and are precipitated into the ionosphere to cause auroras. Particles having large pitch angles are also accelerated but remain trapped and move deep into the magnetosphere to replenish the outer trapping zone and form a ring current. They cause electric polarization which changes the ionospheric current system and drift pattern and may explain low-latitude red arcs and the asymmetric pattern of ionospheric blackouts. 'Explosions' or 'flares' occur in the tail by virtue of the finite-conductivity instability of the long-wave 'teating' mode. These may explain the explosive auroral–geomagentic substorm and the observed 'islands' of trapped energetic electrons. A quantitative discussion is given. (auth)

16719 METEOROLOGICAL INVESTIGATIONS OF THE UPPER ATMOSPHERE. Proceedings of the American Meteorological Society Symposium, Miami Beach, Florida, May 31–June 2, 1967. Meteorological Monographs, Volume 9. Quiroz, R. S. (ed.). Meteorol. Monogr., 9: No. 31, 1-231(Apr. 1968). (CONF-670554).

Separate abstracts were prepared for seven of the twenty-five papers. The other eighteen papers were not in scope for Nuclear Science Abstracts. (W.D.M.)

For abstracts of individual papers see: 16720–16726.

16720 SOLAR INFLUENCES AND THEIR VARIATIONS. Gregory, J. B. (Univ. of Saskatchewan, Saskatoon). Meteorol. Monogr., 9: No. 31, 19-31(Apr. 1968).

From Symposium on Meteorological Investigation above 70 Kilometers, Miami Beach, Fla. See CONF-670554.

Fluctuations of solar output are accompanied by recognizable effects in the F region of the ionosphere. At higher and lower altitudes the effects are less well established. A survey is made of existing knowledge. For altitudes below about 120 km, the role of particle influx, especially in relation to the circulation changes in the atmosphere, has not yet been determined. The possibilities of interrelation between variation of solar input and circulation characteristics are discussed. (auth)

16721 D-REGION PHENOMENA AND STRATOSPHERIC–MESOSPHERIC COUPLING. Lauter, E. A.; Sprenger, K. (Meteorological Service, Kuehlungsborn, Ger.). Meteorol. Monogr., 9: No. 31, 129-38(Apr. 1968).

From Symposium on Meteorological Investigation above 70 Kilometers, Miami Beach, Fla. See CONF-670554.

Coupling effects between D-region plasma and neutral gas in the mesosphere have been found from pronounced seasonal variations in ionospheric absorption and D-region phase heights, as well as from special events and anomalies in the wintertime behavior of the lower ionosphere. The paper presents examples of annual variations of ionospheric absorption and phase height at constant solar zenith angles, the results of investigations of sunrise phenomena in different seasons, and results from ionospheric drift measurements at low frequencies. A quasi semiannual variation in ionospheric absorption is obtained with a wintertime maximum, dominating at high frequencies, and a summertime maximum, dominating at low frequencies. The minima of absorption in spring and autumn indicate a low degree of ionization in the D region, coinciding with abrupt changes in the phase of the tidal drift component in the lower ionosphere and with the well-known reversals of the general circulation in the stratosphere. The lag of summertime conditions behind the summer solstice is found to be different at different heights. In addition to the properties of the behavior of ionospheric absorption during the winter anomaly, special coupling periods during stratospheric warming events are considered. There is now strong evidence that sudden stratospheric warmings are sometimes accompanied by pronounced ionospheric absorption anomalies, but the time shift between the two events is not always constant. There are now also some examples available demonstrating that circulation anomalies in the middle stratosphere, connected with stratospheric warmings, are related to distinct drift anomalies at the 95-km level. (auth)

16722 INFLUENCE OF THE NEUTRAL WIND FIELD ON THE DISTRIBUTION OF IONIZATION IN THE E REGION. MacLeod, Malcolm A. (Air Force Cambridge Research Labs., Bedford, Mass.). Meteorol. Monogr., 9: No. 31, 139-47(Apr. 1968).

From Symposium on Meteorological Investigation above 70 Kilometers, Miami Beach, Fla. See CONF-670554.

The neutral wind field is effective, through mechanisms involving its shear field, in redistributing the ionization of the E region. An equilibrium theory is reviewed in which the ion motion is produced by a balancing of the forces due to neutral collisions and the geomagnetic field. Vertical shear of the horizontal neutral wind is shown to be capable of producing 23 of 28 observed ionization layers. Vertical shear of the vertical neutral wind is shown to be responsible for the production of two layers in a recent experiment. It is suggested that this neutral convergence mechanism may be responsible for the low-altitude layers whose occurrence cannot be predicted by the mechanisms depending solely on vertical shear of the horizontal neutral wind. (auth)

16723 RELATIVE MOTION OF ION AND NEUTRAL CLOUDS. Luest, R. (Max-Planck-Institut fuer Extraterrestrische Physik, Munich). Meteorol. Monogr., 9: No. 31, 148-51(Apr. 1968).

From Symposium on Meteorological Investigation above 70 Kilometers, Miami Beach, Fla. See CONF-670554.

In recent years several experiments with ionized barium clouds have been carried out in the upper atmosphere between 130 and 2000 km. The experimental technique for evaporation and the process of ionization are described. By observing the drift motions of the ionized barium clouds, the electric fields have been determined in the upper atmosphere. Results are given in particular for measurements at mid-latitudes. (auth)

16724 IONOSPHERIC WINDS AND ASSOCIATED GEOMAGNETIC VARIATIONS. Sugiura, Masahisa (Univ. of Washington, Seattle). Meteorol. Monogr., 9: No. 31, 152-7(Apr. 1968).

From Symposium on Meteorological Investigation above 70 Kilometers, Miami Beach, Fla. See CONF-670554.

Studies of geomagnetic quiet daily variations Sq are reviewed with emphasis on the relation of Sq with neutral air motions in the ionosphere. Recent analyses of global Sq and direct observations of electric currents in the ionosphere are summarized. Methods of deducing neutral winds from Sq by dynamo theory are critically examined. A wind system derived from Sq by using the height-integrated conductivity gives an effective wind system which must be interpreted with care. If actual winds vary appreciably with height, as rocket observations indicate, the effective wind system represents only weighted average winds over the dynamo region of the ionosphere, the weights being related to the conductivity distribution. However, given a theoretical wind model, Sq could provide a partial, if not complete, verification of the wind model in the dynamo region; a direct check by wind measurement with rockets, however, will require a prohibitive effort. (auth)

16725 METEOROLOGICAL ROCKET MEASUREMENTS IN THE MESOSPHERE. Webb, Willis L. (Atmospheric Sciences Lab., White Sands Missile Range, N. Mex.). Meteorol. Monogr., 9: No. 31, 158-69(Apr. 1968).

From Symposium on Meteorological Investigation above 70 Kilometers, Miami Beach, Fla. See CONF-670554.

The philosophy of synoptic probing of the mesospheric region is considered in some detail, particularly in light of the required accuracy of data and the relationship between synoptic data and special mesospheric data such as isolated soundings and indirect observations of various natural phenomena (e.g., noctilucent clouds, meteor trail drifts, air glow, and ionospheric inhomogeneities). Progress in upward extension of current Global Meteorological Rocket Network wind, temperature, and ozone sensing systems into the upper portions of the mesosphere is summarized. New rocket-borne sensors for measurements of composition, density, pressure, and electron and ion densities are discussed, and their applicability to a synoptic network is considered. It is concluded that synoptic exploration of the mesosphere is required before a comprehensive knowledge of the Earth's entire atmosphere can be obtained. The tools are available, and the time for mesospheric synoptic probing is now. (auth)

16726 RECENT MEASUREMENTS OF THE LOWER THERMOSPHERE STRUCTURE. Spencer, N. W. (Goddard Space Flight Center, Greenbelt, Md.); Carignan, G. R.; Taeusch, D. R. Meteorol. Monogr., 9: No. 31, 201-7(Apr. 1968).

From Symposium on Meteorological Investigation above 70 Kilometers, Miami Beach, Fla. See CONF-670554.

The measurement of the concentration of the neutral particles in the thermosphere poses difficult tasks that have been the subject of considerable experimental development for many years. Advancing technology is now permitting new measurements, the results of which show high variability of the temperature and concentration of the constituents in response to variations in the energy absorbed. For example, at times of very low solar activity, densities deduced from satellite drag show little diurnal variation at

200 km, but substantial variation as the altitude increases, reflecting approximately a factor of three (maximum to minimum) at 300 km. In contrast, densities and temperatures measured in the lower thermosphere by mass spectrometer techniques at times of low solar activity show significant variation. At 200 km where the concentration of molecular nitrogen and atomic oxygen is approximately equal, the ratio of maximum daytime to minimum nighttime is observed to be approximately 1.8. Recent data, however, do not entirely support these conclusions, showing less variability at the 200-km level with increasing solar activity. (auth)

16727 VLF EMISSIONS DURING MAGNETIC STORMS AND THEIR ASSOCIATION WITH 40-keV ELECTRONS. Cauffman, David P.; Gurnett, Donald A. (Univ. of Iowa, Iowa City). J. Geophys. Res., 74: 1144-57 (Mar. 1, 1969).

Spectrograms of very low-frequency radio noise recorded by Injun 3 at invariant latitudes greater than 50°N are used to determine the behavior of vlf emissions during magnetic storms. Variations in the wide-band intensity of vlf emissions from L = 3 to L = 8 are studied for the period from April 28 to August 28, 1963, by means of the automatic gain control levels of the satellite vlf receiver. During a sudden-commencement magnetic storm the vlf emission called polar chorus characteristically appears at the onset of the storm, may increase in upper frequency extent to ~5 kHz, may change from spike to burst structure (normal chorus), occurs over the greatest area on the fourth day of the storm, subsequently fades into low-frequency spike-structure polar chorus again, and eventually disappears into the elf hiss band generally present. Chorus occurrence shows symmetry about the 9h 00m–21h 00m, magnetic local time meridian with a large maximum in magnetic morning and a smaller maximum in magnetic evening. Daily regions of occurrence are shown for the duration of a prototypical storm. Contour maps of wide-band vlf field strength as a function of shell parameter L and universal time are presented for May through August 1963. A correlation with Dst is observed. The wide-band vlf noise intensity rises from the background noise level at the onset of a magnetic storm and peaks during the early recovery phase. The Kennel–Petschek limiting flux hypothesis is investigated by by looking for vlf noise on the appropriate L shells when equatorial ≥40-keV electron fluxes reach predicted limiting values. The vlf noise levels predicted in the equatorial plane by Kennel and Petschek are not observed at the altitude of the Injun 3 satellite (less than 2785 km). (auth)

16728 A MASS SPECTROMETRIC INVESTIGATION OF THE LOWER THERMOSPHERE ABOVE FORT CHURCHILL WITH SPECIAL EMPHASIS ON THE HELIUM CONTENT. Mueller, D.; Hartmann, G. (Univ., Bonn). J. Geophys. Res., 74: 1287-93 (Mar. 1, 1969).

A quadrupole mass filter, designed for rocket-borne measurements of the thermosphere helium content, is described. This instrument was flown from Fort Churchill, Canada, on December 12, 1966, 1305 LT, and gave data in the altitude range of 110 to 155 km. The measured helium number densities were found to be higher by a factor of 5 than predicted by CIRA 1965. In addition, the density profiles of nitrogen (N_2) and molecular oxygen (O_2) were also obtained. Some conclusions concerning the turbopause level and the winter helium bulge are drawn. (auth)

16729 SCINTILLATIONS OF SATELLITE SIGNALS BY IONOSPHERIC IRREGULARITIES WITH SHARP BOUNDARY. Basu, S.; Das Gupta, A. (Calcutta Univ.). J. Geophys. Res., 74: 1294-1300 (Mar. 1, 1969).

The paper investigates the diffraction of vhf radio waves from satellites by ionospheric irregularities with a sharp boundary, e.g., sporadic E. By the use of classical Fresnel's theory, it is found that the nature of diffraction pattern depends on the phase shift introduced by the irregularity. Typical records obtained from satellites BEB and BEC are also presented. (auth)

16730 ACCELERATION OF PARTICLES REFLECTED AT A SHOCK FRONT. Sonnerup, B. U. Ö. (Dartmouth Coll., Hanover, N. H.). J. Geophys. Res., 74: 1301-4 (Mar. 1, 1969).

In a recent paper Asbridge et al. (1968) reported convincing evidence for particle reflection and acceleration at the bow shock, obtained from the particle experiments on board a series of Vela satellites. Typically, the energy of these reflected particles, believed to be mainly protons, is observed to be of the order of 4 to 6 times that of an average solar-wind proton. It is the purpose of the present paper to demonstrate that particle energization of this magnitude or greater is expected to occur in the reflection process. The responsible agent is the interplanetary electric field, and the acceleration takes place because the particles are displaced in the direction of that field in the reflection process. (W.D.M.)

16731 VARIATION OF GEOMAGNETIC DISTURBANCE WITH LATITUDE. Moe, Kenneth (McDonnell Douglas Astronautics Co., Santa Monica, Calif.); Nebergall, Dean. J. Geophys. Res., 74: 1305-7 (Mar. 1, 1969).

Geomagnetic disturbance occurs when the flow of solar wind is enhanced. Many authors have offered explanations of how the energy of the enhanced solar wind is transferred into the geomagnetic cavity, and how it is further transformed inside. This subject has recently been reviewed by Obayashi (1967). The data in this paper were collected for use in a quantitative test of Cole's (1962, 1966) theory of the increase in atmospheric density during geomagnetic storms. (W.D.M.)

16732 IRREGULAR REGIONS IN THE ANTARCTIC IONOSPHERE. Titheridge, J. E.; Stuart, G. F. (Univ. of Auckland, N. Z.). J. Geophys. Res., 74: 1308-10 (Mar. 1, 1969).

Amplitudes of the 20- and 40-MHz signals from S-66 have been recorded at Scott Base since Oct. 1964. Fourteen transits are recorded each day, giving information on conditions over a large part of the Antarctic ionosphere including the geographic, geomagnetic, and dip poles and extending across the auroral zone. Small-scale irregularities in the ionosphere cause fluctuations in the polarization angle of the received signals, so that the nulls in the Faraday fading patterns become less clear. A measure of the density of the irregularities can therefore be obtained from the clarity of the nulls on the different frequencies. This has been done at intervals of 0.2 min throughout each transit, using a scale of 1 to 5. This scale has been described previously where results from 3000 transits were combined to produce maps showing the mean degree of irregularity of the ionosphere throughout the Antarctic. Diurnal, solar, and magnetic activity effects were discussed by Stuart and Titheridge (1969). In the present note results for individual days are considered to determine the size and movement of irregular regions in the ionosphere. (W.D.M.)

16733 DIURNAL VARIATION OF ELECTRON PRODUCTION RATES IN THE D REGION. Thrane, E. V. (Environmental Science Services Administration, Boulder, Colo.). J. Geophys. Res., 74: 1311-16 (Mar. 1, 1969).

Recently, Thrane et al. (1968) have measured the diurnal variation of the electron concentration in the undisturbed D region at middle latitudes by means of the partial reflection and cross modulation techniques. Some of their results are shown. The purpose of this note is to test whether these measurements are consistent with the hypothesis that ionization of NO by solar Lyman-α is the dominant production mechanism at about 80 km. This is done by comparing the solar zenith angle dependence of electron production rate expected on theoretical grounds with estimates of production rates based on the experimental data. (W.D.M.)

16734 ENERGETIC ELECTRONS AT LATITUDES ABOVE THE OUTER-ZONE CUTOFF. Vampola, A. L. (Aerospace Corp., El Segundo, Calif.). J. Geophys. Res., 74: 1254-69 (Mar. 1, 1969).

Measurements made by a nine-channel magnetic spectrometer (energy range 225 keV to 2.47 MeV) on a polar-orbiting vehicle indicate that energetic electrons from solar flares have access to the polar zones. Electrons were observed at invariant latitudes above the outer-zone cutoff. Isotropic fluxes with no spatial structure were observed over the entire polar zone sampled. Fluxes were independent of altitude over the range of 400 to 4000 km and B between 0.13 and 0.48 gauss. Approximately exponential decays of 0.67 and 0.80 days were observed for the August 29 and September 2, 1966, event. Typical spectra could be fit with power law functions with exponents between 3.0 and 3.6 for these two events. The January–February period in 1967 exhibited much harder electron spectra, with an exponential function providing the best fit with E_0 between 285 and 425 keV. Subsolar and antisolar polar flux merges with the outer-zone flux were distinctly different during the early phase of an event. (auth)

16735 RESISTANCE OF THE MAGNETOSPHERE. Drummond, J. E.; Nelson, D. J. (Boeing Scientific Research Labs., Seattle). J. Geophys. Res., 74: 1270-4 (Mar. 1, 1969).

The dc electrical resistance that would be measured between two satellites (plus their sheaths) separated by a vertical distance very small compared with the radius of the Earth but very large compared with the thickness of either satellite is calculated. The nonlinear current–voltage relation of the satellite sheaths is also calculated as is the current–voltage relation when the lower satellite has a thermionically emitting hot spot. (auth)

16736 ACCELERATION OF TRAPPED ELECTRONS AND PROTONS THROUGH BIMODAL DIFFUSION IN THE EARTH'S RADIATION BELTS. Theodoridis, George C.; Paolini, Frank R.; Frankenthal, Shimshon (American Science and Engineering, Inc., Cambridge, Mass.). J. Geophys. Res., 74: 1238-53 (Mar. 1, 1969).

A computer model was used to study the effect of bimodal diffusion on particle intensity profiles and energy spectra under a

variety of conditions. Through the action of bimodal diffusion, an outer belt of energetic electrons can be created, with detailed spatial features governed by the L dependence of the particle transition probabilities for undergoing one or the other diffusion mode. If magnetic storms are simulated by enhancing constant-μ diffusion over constant-E diffusion and displacing the trapping boundary inward, then low-energy electron intensities in the outer belt rise, while high-energy intensities decrease at the start of the storm but subsequently increase. At infrequent intervals, unusually strong magnetic storms may push electrons into the inner-belt region. Once there, these electrons may remain trapped for a long time owing to the absence of strong perturbing mechanisms. Acceleration of trapped protons through bimodal diffusion can account for high-energy trapped protons in the inner-belt region. The effects of bimodal diffusion are less obvious for low-energy proton intensity profiles, and are of consequence mostly at higher L shells; generally speaking, low-energy protons can be accounted for by constant-μ diffusion acting alone. The widely different spatial patterns and temporal behavior displayed by the proton and electron belts can be understood as resulting primarily from different ratios of constant-E to constant-μ diffusion rates for the two particle species. A typical L-dependence pattern of trapped-particle energy spectra in the presence of bimodal diffusion consists of a domain at low L's where spectra become softer with increasing L and a domain at higher L's where spectra are independent of L. The point of transition between the two domains and the absolute values of the spectral parameter E_0 (approximate e-folding energy of the integral particle intensity) depend primarily upon the energy spectrum and the location of the particle source and the ratio of constant-E to constant-μ diffusion rates. Sequences simulating geomagnetic events produce various spatial and temporal patterns of trapped-particle energy spectra very similar to those actually observed in the radiation belts. (auth)

16737 ASPECT SENSITIVITY OF HF AURORAL ECHOES. Bates, Howard F.; Albee, Paul R. (Stanford Research Inst., Menlo Park, Calif.). J. Geophys. Res., 74: 1164-8 (Mar. 1, 1969).

A simple model of auroral backscatter from the E region that includes ordinary ionospheric refraction is developed quantitatively. When the resulting computations are compared with experimental hf auroral backscatter data, a lower limit of 6 db per degree in the 15- to 50-MHz region is found for the aspect-sensitive decrease in backscatter cross section with off-perpendicular angle from the geomagnetic field. When combined with recent vhf and uhf results, this result leads to the conclusion that the aspect sensitivity of the E-layer auroral echoes is almost constant between 15 and 1200 MHz. (auth)

16738 HF-BACKSCATTER OBSERVATIONS OF SPORADIC E DURING THE IQSY. Baggaley, W. J. (Univ. of Sheffield, Eng.). J. Geophys. Res., 74: 1169-83 (Mar. 1, 1969).

Observations of sporadic-E activity were carried out during the IQSY from the United Kingdom using a fixed-frequency, swept-azimuth oblique backscatter sounder operating at 17 Mc. Ground scatter by means of sporadic-E ionization was presented on a P.P.I. display and recorded on 16-mm film. Analysis of the film data has shown that, in the north temperate latitudes, E_s occurrence for $fE_s > 4$ Mc is predominantly a daytime phenomenon with a well-defined peak at the summer solstice. The enhanced activity in summer was characterized by both an increase in the occurrence of E_s patches with $fE_s > 4$ Mc having enhanced electron content and by an increase in the number of such long duration clouds. The azimuthal distribution of the observed activity has been shown broadly to be in accord with the differential land–sea backscatter; although some deviations from that expected from previous surveys of temperate latitude behavior are indicated. A low occurrence of E_s activity was generally correlated with magnetically disturbed days. Examination of the individual E_s clouds has indicated a most probable patch size of 127 km and a most probable velocity of about 30 m/sec. The directions of motion of clouds showed some preference to the WSW. (auth)

16739 WINTER D-REGION ELECTRON CONCENTRATION AND COLLISION FREQUENCY FEATURES OBTAINED WITH HIGH-POWER INTERACTION MEASUREMENTS. Lee, H. S.; Ferraro, A. J. (Pennsylvania State Univ., University Park). J. Geophys. Res., 74: 1184-94 (Mar. 1, 1969).

A critical study of D-region electron concentrations and collision frequencies that were obtained from a high-power wave interaction experiment is presented. Daily, mean hourly, and mean midday electron concentration profiles for undisturbed winter 1968 are discussed. The feature of a valley that is consistently observed near 70 km is carefully examined. An average winter collision-frequency model is presented. It has been noted that morning and afternoon values of collision frequency are 10% higher than midday values. (auth)

16740 REGULAR DISTURBANCE IN THE TOPSIDE IONOSPHERE. Titheridge, J. E. (Univ. of Auckland, New Zeal.). J. Geophys. Res., 74: 1195-1204 (Mar. 1, 1969).

Continuous records of the electron content of the ionosphere, obtained over a period of several years, have shown that a large disturbance occurs between 10 P.M. and 1 A.M. on about half the nights in summer. After an initial small decrease, the electron content increases rapidly by about 30% and occasionally up to 80%. The increase lasts for 15 to 100 minutes and may be followed by large oscillations. The effects are generally confined to the topside ionosphere, where the electron concentration must fluctuate through a factor of 2 or more. The disturbance consists of an extended wavefront at latitudes less than 40°S, moving toward the northwest with a velocity of 140 m/sec. The front has a depth of several hundred kilometers and dies out within a few thousand kilometers. There is no relation with magnetic activity, but the occurrence increases with sunspot number. (auth)

16741 METHODS FOR THE MEASUREMENT OF VERTICAL IONOSPHERIC MOTIONS NEAR THE MAGNETIC EQUATOR BY INCOHERENT SCATTERING. Woodman, R. F.; Hagfors, T. (Jicamarca Radar Observatory, Lima). J. Geophys. Res., 74: 1205-12 (Mar. 1, 1969).

Methods are discussed for the measurement of motions of the ionosphere by means of Doppler shifts of incoherent-scatter-frequency spectra. It is found that velocities can be measured with an accuracy of better than a few meters per second with integration times of a few minutes, provided the antenna beam is directed approximately perpendicular to the geomagnetic field. (auth)

16742 NIGHTTIME ELECTRIC FIELDS AND VERTICAL IONOSPHERIC DRIFTS NEAR THE MAGNETIC EQUATOR. Balsley, Ben B. (Jicamarca Radar Observatory, Lima). J. Geophys. Res., 74: 1213-17 (Mar. 1, 1969).

Experimental evidence is presented that supports the theoretical concept that the vertical motion of ionization in the equatorial F region is controlled by electric fields originating in the underlying E region. (auth)

16743 TWILIGHT OBSERVATIONS OF UPPER ATMOSPHERIC SODIUM, POTASSIUM, AND LITHIUM. Gault, W. A.; Rundle, H. N. (Univ. of Saskatchewan, Saskatoon). Can. J. Phys., 47: 85-98 (Jan. 1, 1969).

Twilight resonance emissions due to atmospheric sodium, lithium, and potassium have been measured for over one year. The existence of the potassium resonance line was verified by using an absorption cell. Several problems of measuring the emissions and of subsequently calculating a density distribution are discussed. The widths of about 13 km and the topside scale heights of about 4.5 km obtained for the sodium layer are significantly less than obtained at Saskatoon in previous measurements. Atmospheric transmission functions have been recalculated with the results that the sodium and lithium layers are both at about the same height of around 90 km. A lower height of about 85 km was obtained for the potassium layer. The seasonal variations of sodium and lithium twilight abundances are shown to be similar with additional sharp enhancements of lithium abundances thought to be due to natural and man-made injections of lithium. Any seasonal variations of the potassium abundances in the lower layer were masked by large day-to-day fluctuations. (auth)

Low-Temperature Physics

Refer also to abstracts 16906 and 17059.

16744 (SLAC-PUB-528) RECENT DEVELOPMENTS IN THE DESIGN OF SUPERCONDUCTING MAGNETS. Brechna, H. (Stanford Linear Accelerator Center, Calif.). Dec. 1968. 63p. (CONF-681119-2). Dep. CFSTI.

From Meeting of the American Physical Society, Miami Beach, Fla.

The most important magnets, available or currently being built, are described to illustrate the advances of the past two to three years in superconducting magnets. Type-II superconductors, which are commercially available and have been shaped and processed into various types of magnet conductor, such as Nb_xTi and Nb_3Sn, are considered specifically. Medium-size solenoids and Helmholtz configurations, beam transport, and large experimental magnets are covered. (M.H.R.)

16745 (SLAC-Trans-90) FIELD EMISSION FROM A SUPERCONDUCTOR. Leger, A. Translated by Walter G. Robinson (Stanford Linear Accelerator Center, Calif.), from J. Phys. (Paris), 29: 646-54 (1968). 33p. Dep. CFSTI.

An abstract from the original French article appeared as NSA 22: 52684. (M.H.R.)

16746 (UCRL-18536) EFFECTS OF FINE PRECIPITATES ON CRITICAL CURRENT DENSITIES OF SUPERCONDUCTING NIOBIUM 1 PERCENT ZIRCONIUM. Suenaga, Masaki (California Univ., Berkeley. Lawrence Radiation Lab.). Jan. 1969. Contract W-7405-eng-48. 58p. Dep. CFSTI.

Thesis.

A simple model for flux pinning by nonsuperconducting precipitates was developed and was compared with the experimental results on Nb–1% Zr alloy. The model predicted that critical current densities, J_c, were approximately proportional to $(b/\delta)^{\frac{1}{2}}(J/2\kappa^2-1)^{\frac{1}{2}}(H_{c_2}-H/H)$ for $b \ll \delta$ where 2b is the diameter of precipitate, 2δ is the interparticle spacing, J is the energy of a flux line, κ is the Landau–Ginzburg constant, H_{c_2} is the upper critical field of the alloys, and H is the applied field. The magnetic field dependence of J_c was in good agreement with experimental results in the cases of intermediate pinning strength. But, for very weak or strong pinning strength, departure of experimental and theoretical results was noted at higher fields. Although it was very difficult to determine exact slopes of a plot $\ln [J_c/(b)^{\frac{1}{2}}]$ vs $\ln \delta$ due to experimental scatter in measured b and δ, the size and the spacing dependence of J_c was thought to be reasonably consistent with the experimental results in spite of simplifying assumptions used in the model. For measurements of b and δ of precipitates, ZrO_2, a carbon extraction replica method was employed. Transmission electron and optical microscopies were also used to investigate the precipitates. H_{c_2} (4.2°K) and J_c were measured with use of a superconducting magnet. Critical temperatures, T_c of the alloys were also measured, and it was found that T_c, 9.3°K, varied less than 0.2°K with heat treatments. (auth)

16747 SECOND SOUND VELOCITY IN He II, THERMAL CONDUCTIVITY IN He I, AND SCALING LAWS NEAR THE SUPERFLUID TRANSITION. Ahlers, G. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. Lett., 28A: 507-8(Jan. 13, 1969).

It is shown that the measured thermal conductivity of He I and scaling arguments yield a second sound velocity for He II in agreement with that calculated from hydrodynamics for $T_\lambda - T \geq 10^{-7}$°K. This is contradictory to the recent direct measurements by Johnson and Crooks. (auth)

16748 ELECTRONIC SPECIFIC HEAT AND SUPERCONDUCTING PROPERTIES OF Nb–Ta ALLOYS. Corsan, J. M.; Cook, A. J. (National Physical Lab., Teddington, Eng.). Phys. Lett., 28A: 500-1(Jan. 13, 1969).

Measurements of the electronic specific heat coefficient γ, θ_{Debye} and superconducting transition temperature of Nb–Ta alloys show that the BCS parameter "V" is almost constant for this system. The Ginzburg–Landau parameter K_1 (0) and the superconducting energy gap are calculated. (auth)

16749 CURRENT DISTRIBUTION IN A TYPE-II SUPERCONDUCTING THIN FILM, AND ITS RELEVANCE TO THE DC SUPERCONDUCTING TRANSFORMER. Daniels, J. M. (Univ. of Toronto). Can. J. Phys., 47: 389-92(Feb. 15, 1969).

Using the model of the viscous motion of flux lines in a type-II superconductor, an expression is found for the current and field distribution in a superconducting film in the flux-flow regime. The current is peaked near the edges of the strip, the field is constant through the strip, and is very large just outside the strip close to the edges. The presence of this large field could inhibit the movement of vortices in the secondary of a dc transformer if the secondary overlaps the primary laterally. (auth)

16750 SUPERFLUID EXPONENT ζ FROM SELF-CONSISTENT LANDAU–GINZBURG THEORY. Tyson, J. A. (Univ. of Sussex, Brighton, Eng.). Phys. Lett., 28A: 526-7(Jan. 13, 1969).

The solution $\zeta = \frac{2}{3}$ is obtained from the condition that the Landau–Ginzburg free energy expansion remain consistent for $T \to T_\lambda$. This result is independent of the critical exponents η and ν. (auth)

16751 CONDUCTIVITIES IN NORMAL METALS FROM MEASUREMENTS ON SUPERCONDUCTORS. Grimvall, Goeran (Inst. of Theoretical Physics, Goteborg). Phys. Kondens. Mater., 8: 202-8(1968).

A calculation of the high-temperature electrical resistivity for lead, indium, and tin is performed starting from data obtained when the gap equation for tunneling in superconductors is inverted. A main result is the average $1 - \cos\Theta$ where Θ is the scattering angle. The result is discussed in detail. (auth)

16752 EFFECT OF PRESSURE AND ^{3}He-CONCENTRATION ON THE TEMPERATURE T_λ IN ^{3}He–^{4}He MIXTURES. Byckling, E. (Univ. of Oulu, Finland). Physica, 38: 285-6(Apr. 5, 1968).

In ^{3}He–^{4}He mixtures the λ-transition temperature T_λ depends on concentration $x = N_3/(N_3 + N_4)$ and pressure p. A connection between the derivatives $\partial T_\lambda/\partial x$, $\partial T_\lambda/\partial p$, and the dependence of the ^{4}He effective mass m* on x, p is pointed out. (M.H.R.)

16753 HEAT TRANSFER BELOW 0.2°K. Suomi, M.; Anderson, A. C.; Holmstroem, B. (Technical Univ. of Helsinki, Otaniemi, Finland). Physica, 38: 67-80(Mar. 10, 1968).

Experiments in the temperature range 0.02 to 0.2°K are described which give direct evidence for 1) a Kapitza or thermal boundary resistance between foils and a slurry of chrome alum in oil, obeying the relation 3×10^{-6} T^{-3} A^{-1} °K s/erg, 2) a thermal resistance due to diffusion within the slurry, given by 5×10^{-6} T^{-3} $A^{-1}L$ °K s/erg, 3) a thermal boundary resistance between copper and superconducting indium of 8×10^{-7} T^{-3} A^{-1} °K s/erg, and 4) an extremely small thermal resistance in threaded mechanical copper/copper joints due to heat transfer by electrons. These results are compared to calculations based on the acoustic mismatch theories, and with earlier experiments on analogous systems. (auth)

16754 DILUTE MIXTURES OF ^{3}He IN SUPERFLUID ^{4}He. Stenholm, S.; Ter Haar, D. (Oxford Univ.). Physica, 38: 133-54(Mar. 10, 1968).

The properties of a single ^{3}He impurity in liquid ^{4}He at zero temperature are discussed. An exact perturbation expansion is developed. All properties of the boson system are assumed known and the single particle fermion propagator is expressed in terms of these. An approximation is introduced which makes the diagrammatic expression correspond to the fermion interacting with the elementary excitations of the Bose system. The analytic properties of the boson–fermion vertices are investigated. Various expressions for the effective mass of the fermion are discussed and temperature corrections are shown to be negligible. The main contribution to the change in mass is found to come from the interaction with virtual rotons. Experiments are used to estimate some of the parameters of the theory. It is found that the weight of the quasiparticle pole is only about $\frac{1}{3}$. Finally a comparison with other recent theoretical work is made. (auth)

16755 EXISTENCE PROOF FOR THE GAP EQUATION IN THE SUPERCONDUCTIVITY THEORY. Billard, P.; Fano, G. (Univ. d'Aix-Marseille). Commun. Math. Phys., 10: 274-9 (1968).

An existence theorem for the "gap equation" in the superconductivity theory is given, as a consequence of the Schauder–Tychonoff theorem. Sufficient conditions on the kernel are given, which ensure the existence of a solution among a particular class of continuous functions. The case of a positive kernel is studied in detail. (auth)

16756 ON SUPERCONDUCTIVITY. Gorter, C. J. (Kamerlingh Onnes Laboratorium, Leiden). pp 857-72 of Theory of Condensed Matter. Vienna, International Atomic Energy Agency, 1968.

STI/PUB-205.

A short historical and general introduction is followed by the thermodynamical explanation of the disturbance of superconductivity of high magnetic fields and of the occurrence of an intermediate state. Meissner's effect and London's equations are discussed. The introduction of an order parameter is advocated as well as the Ginsburg–Landau refinement in which such a parameter receives a complex character as well as spatial stiffness. The value of the G–L formalism for interpretation of the mixed superconductive state and its properties is explained. After the general importance of the energy gap in superconductors and of the BCS theory has been stressed, a few applications, in particular of type-II superconductors in the mixed state, are mentioned. (auth)

16757 SPIN CORRELATIONS IN PARAMAGNETIC SUPERCONDUCTORS. Guertin, R. P.; Parks, R. D. (Univ. of Rochester, N. Y.). Solid State Commun., 7: 59-61(Jan. 1969).

Anomalous behavior observed in the dependence of the superconducting transition temperature of $Th_{1-x}Er_x$ on Er concentration is related to the onset of spin–spin correlations among the Er impurities. (auth) (UK)

16758 AN ANOMALY IN THE ULTRASONIC ATTENUATION IN STRONG COUPLING AND IMPURE SUPERCONDUCTORS. Nam, Sang Boo (Rutgers-The State Univ., New Brunswick, N. J.). J. Korean Phys. Soc., 1: 1-4(Mar. 1968).

General expressions for the ultrasonic attenuation response are derived by using a Green's function method. They are sufficiently general to apply to strong-coupling superconductors and to superconductors with magnetic impurities. In the appropriate limit, the BCS result is obtained. The coefficient of the ultrasonic attenuation consists of two terms; one comes from scattering at frequencies

below the effective energy gap, and the other from exciting pairs of quasi-particles from the ground state to above the gap. This second process yields a discontinuity, $\delta(\alpha_s/\alpha_n) = r(\pi/2)\tanh(\omega_g T)/2k_B T)$, in the coefficient of the ultrasonic attenuation in the superconducting state at the temperature such $2\omega_g(T) = \omega$. The calculations account very well for the recent experiments on α_s in Al, Hg, and Pb. (auth)

16759 THERMODYNAMIC STABILITY OF SUPERFLUID FLOW THROUGH A CHANNEL. Kramer, Lorenz (Stanford Univ., Calif.). Phys. Rev., 179: 149-55(Mar. 5, 1969).

The limit of metastable existence of parallel superflow through channels is found by examining the second variation of the free energy. The corresponding critical velocity V_{cl} is calculated with the quasiparticle model and with the Ginzburg–Pitaevskii theory. V_{c1} reduces to the Landau velocity for $T \to 0$ and tends to zero for $T \to T_\lambda$. The behavior of the system above V_{c1} is discussed. There is qualitative agreement with experiments on hot ions drifting through He(II). (auth)

16760 CRITICAL HEAT FLUX IN LIQUID HELIUM II CLOSE TO THE λ TRANSITION. Mikeska, H. J. (Univ. of Maryland, College Park). Phys. Rev., 179: 166-73(Mar. 5, 1969).

A critical heat flux in superfluid helium is defined applying Landau's criterion for critical velocities to second sound. The velocity of second sound is calculated in the presence of a heat flux and vanishes in the direction of the heat flux at its critical value. As the second-sound modes are the critical modes connected with the λ transition this mechanism is expected to be important close to T_λ. Numerical results are obtained from an assumption about the dependence of the entropy on the relative velocity of the normal and superfluid components. They are in reasonable agreement with experimental results. (auth)

16761 SURFACE TENSION AT THE ^{3}He–^{4}He INTERFACE. Brouwer, W. (Univ. of Alberta, Edmonton); Pathria, R. K. Phys. Rev., 179: 209-11(Mar. 5, 1969).

An estimate is made of the interfacial surface tension in a phase-separated mixture of ^{3}He–^{4}He on the basis of Atkins' approach. A corresponding experimental study should elucidate the role played by the vibrational surface modes of a quantum fluid. (auth)

16762 SUPERFLOW IN HELIUM FILMS: THIRD-SOUND MEASUREMENTS. Kagiwada, R. S. (Univ. of California, Los Angeles); Fraser, J. C.; Rudnick, I.; Bergman, D. Contract AT(11-1)-GEN-10. Phys. Rev. Lett., 22: 338-42(Feb. 24, 1969).

The results of measurements of third-sound velocity in adsorbed superfluid helium films (1.12 to 1.85°K) are presented. It is found that the average superfluid fraction is nonvanishing at the superflow onset thickness and has a value about $^3/_8$ its bulk value. Possible reasons for a nonvanishing value are discussed. Healing lengths based on best fitting Ginzburg–Pitaevskii calculations are determined. (auth)

16763 QUANTUM THEORY OF ^{4}He MONOLAYERS. Jackson, H. W. (Ford Motor Co., Dearborn, Mich.). Phys. Rev., 180: 184-92(Apr. 5, 1969).

A quantum theory of adsorbed, mobile monolayers of ^{4}He is developed. The formalism, which includes consideration of both the ground state and the excited states, is followed by numerical results for experimentally interesting examples. (auth)

16764 ^{3}He–^{4}He SOLUTIONS. Phillips, Norman E. (Univ. of California, Berkeley). Annu. Rev. Phys. Chem., 19: 559-84(1968).

Work on ^{3}He–^{4}He solutions at low temperatures is reviewed under the following main sections: (1) a discussion of the properties of the liquid solutions at low pressures; (2) a brief description of the rather complicated phase diagram at higher pressures; and (3) properties of the solid phases, to the limited extent that they have been determined. 156 references. (M.H.R.)

16765 THE LOW-TEMPERATURE TRANSPORT PROPERTIES OF $NbSe_2$. Lee, H. N. S.; McKinzie, H.; Tannhauser, D. S.; Wold, A. (Brown Univ., Providence). J. Appl. Phys., 40: 602-4(Feb. 1969).

The resistivity and Hall effect of single crystals of the two-layer structure of $NbSe_2$ were measured from about 5 to 300°K. A sign change was observed in the Hall coefficient at about 26°K; above this temperature the samples were p type, and below, n type. (auth)

Plasma and Thermonuclear Physics

Confinement and Heating

Refer also to abstract 17304.

16766 (CEA-R-3523) CONFINEMENT OF A NONCYLINDRICAL DISCHARGE BY A CUSP GEOMETRY. Watteau, Jean-Paul H. (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes). Nov. 1968. 117p. (In French). Dep.

Thesis. Submitted to Univ. of Paris, Faculte des Sciences, France.

The plasma of a noncylindrical z discharge is accumulated in the center of a cusp geometry and then captured and confined by the rising cusp magnetic field. The cusp geometry is produced by two identical coaxial coils the currents of which are equal but in opposite directions. Stability and confinement properties of this zero minimum-B geometry are recalled; in particular it is shown (the coils cross section being supposed punctual) that the magnetic well depth of the configuration without plasma is maximum for an optimum coils distance. Two modes of confinement are observed experimentally: (1) A collisional mode for which the plasma confinement is limited to 10 μsec (temperature 5 eV, density 7×10^{16} cm^{-3}) as a result of the gradual interpenetration of the plasma and of the magnetic field. (2) A collisionless mode (temperature 40 eV) where the radial leak thickness is of the order of the ion cyclotron radius. Plasma accumulation occurs even without confinement and is due to the noncylindrical shape of the discharge chamber. The two-dimensional snowplow model gives good account of the discharge dynamics. A comparison is made with plasma focus experiments: in particular experimental conditions (deuterium, pressure 1 torr, energy 3 kJ, current 100 kA) a 10^7 neutron yield is detected which appears to be connected with the unstable behavior of the discharge. (auth)

16767 (N-68-33372) PREHEATING OF PLASMA IN A MEGAJOULE THETA-PINCH EXPERIMENT. Cilliers, W. A.; Norwood, Joseph Jr.; Oertel, G. K. (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). Sept. 1968. 22p. (NASA-TN-D-4708). CFSTI.

The preheating of plasma in a megajoule theta-pinch experiment was investigated and distinct modes of operation have been delineated. The criteria for satisfactory preionization are discussed. For typical experiments where a number of discharges from different capacitor banks are applied sequentially to a common load, these criteria are determined not only by the requirement for a reproducible and stable plasma, but also by the limitations on the voltage that can be applied to the coil without precipitating prefire of banks that should fire later in the sequence. A range of preheater energies and a bank voltage that are satisfactory for this particular experiment were determined. Streak photographic evidence of plasma conditions in the various modes is presented. (auth) (STAR)

16768 (NP-17779) LONG-WAVE PERTURBATIONS OF STELLARATOR MAGNETIC SYSTEM GEOMETRY. Danilkin, I. S. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). 1968. 48p. (In Russian). Dep.

Long-wave perturbations of geometric parameters in a stellarator magnetic system were studied so that the most critical geometric distortions might be revealed. Comparisons of effective amplitudes of these perturbations revealed, in particular, that geometric nonaxiality of the conducting systems producing longitudinal and helical fields belongs to the group of such critical perturbations. In such a case, the basic resonance in the preaxial region may induce shifting of the magnetic axis system of the aperture arrangement of a vacuum chamber ~0.1 R_0 at the nonaxiality magnitude ~10^{-3} R_0, which in turn would demand precision adjustments or a special system for compensation of such possible field perturbations. (tr-auth)

16769 (NP-17781) PLASMA HEATING FROM NONLINEAR EFFECTS OF LARGE AMPLITUDE ALFVEN WAVES. Watson-Munro, C. N.; Cross, R. C.; James, B. W. (Sydney Univ. (Australia). School of Physics). Sept. 1968. 24p. (ER-41). Dep.

In a cylindrical, highly ionized hydrogenous laboratory plasma source, the propagation of Alfvén torsional waves of azimuthal wave field b_θ propagating parallel to a steady magnetic field B_θ in the z direction was studied. The situation was studied up to perturbation ratios b_θ/B_θ of 7.4 and Alfvén Mach Numbers M_A up to 3. It was found that up to a perturbation ratio of about 1.3 theoretical predictions from MHD shock wave theory of shock velocity, density and temperature behind the shock are experimentally realized. Above this perturbation ratio, theory and experiment depart; marked attenuation of the Alfvén wave occurs and large amplitude oscillations develop. (auth)

16770 TURBULENT HEATING OF PLASMA IONS DURING DEVELOPMENT OF ELECTRON-ACOUSTIC INSTABILITY. Sizonenko, V. L.; Stepanov, K. N. (Physical-Technical Inst., Kharkov). Zh. Eksp. Teor. Fiz., 56: 316-32(Jan. 1969). (In Russian).

Weak turbulence is investigated in a plasma with hot ions and

cold electrons in which small-scale high-frequency electron–acoustic instability develops as a result of ion motion with respect of electrons in a circularly polarized electromagnetic wave electric field with a frequency of the order of the ion cyclotron frequency ω_{Hi}. It is shown that a stationary electron–acoustic pulsation spectrum is established during a period of time of the order of $1/\omega_{Hi}$ in a reference system rotating together with the wave. The spectrum has a peak in wave vector (k) space which exceeds the thermal noise level by several orders of magnitude. Ion scattering on electron–acoustic oscillations leads to an increase of the thermal ion energy which is transverse with respect to the external magnetic field. Expressions are obtained for the spectral intensity of electron–acoustic oscillations by taking into account their nonlinear interaction. A quasi-linear equation is derived for the background ion distribution function defining turbulent ion heating. The heating time is estimated. A number of experiments on plasma heating by ion-cyclotron and fast magnetosonic waves are discussed in which anomalous wave absorption was observed. It is shown that the anomalies can be explained by excitation of beam instability of the plasma in the electric field of the waves and, in particular, by excitation of electron–acoustic instability. (auth)

16771 THERMONUCLEAR REACTOR AND PROCESS. Post, R. F. (to United States Atomic Energy Commission). Canadian Patent 797,998. Oct. 29, 1968.

Provision is made for the containment of the reaction plasma within a vacuum by establishing an axially symmetric, manipulated magnetic field. This is provided in such a manner that the intensity in longitudinally spaced or nodal regions is gradientially increased, while in the intervening space between these regions of magnetic intensity, the field is of relatively lower intensity. Deuterium and tritium are suggested as preferred fuels. The contained particles describe helical paths. The gradientially increased magnetic fields may be considered to be terminal reflectors or closures of the containment zone, while the central portions of the field provide radial closure. Thermonuclear fuel ions are introduced into the containment zone. Provision is made for heating the accumulated preheated charge by adiabatic compression obtained by increasing the intensity of the overall magnetic field favoring a sharper increase in the reflector regions and by causing such reflector field regions to more proximally along the longitudinal axis. Decompression is caused by manipulation of the magnetic field, whereby the plasma is allowed to expand after initiation. Such expansion may be employed to reduce and regulate the rate of reaction while in progress. Accessory apparatus for utilizing the nuclear particles, heat, kinetic energy of combusion, and other products or effects of the reaction are also provided. Electrical energy for an external circuit is the end result. A detailed mathematical discussion in support of the method. Sixty-six claims are made. (F.S.A.)

16772 SOME NEW RESULTS CONCERNING THE RADIATION PRESSURE ON THE PLASMA-VACUUM BOUNDARY. Klima, R.; Petrzilka, V. A. (Inst. of Plasma Physics, Prague). Czech. J. Phys., 19: 35-43(1969).

The radiation pressure is studied by means of the tensor of time-averaged stresses arising in plasma under the effect of a magnetostatic and an oscillating field. It is proved that the radiation pressure need not arise on the plasma–vacuum boundary even if the electromagnetic wave falling from vacuum is reflected substantially. The density of momentum flux defined by the stress tensor is compared with the density of the electromagnetic field momentum. (auth)

16773 TURBULENT PLASMA HEATING IN A TORUS. Fanchenko, C. D.; Demidov, B. A.; Elagin, N. I.; Perepelkin, N. F. Dokl. Akad. Nauk SSSR, 183: No. 1, 77-9(Nov. 1, 1968). (In Russian).

The possibility of containing a turbulently heated plasma of toroidal configuration after removal of the heating current is investigated with the use of 20 titanium-hydride, plasma injectors which could create a plasma having a density between 10^{11} and 5×10^{13} particles/cm^3. Magnetic coils provided a strongly crimped, quasistationary magnetic field which had the configuration of a crimped torus near the magnetic axis, and a pointed geometry at the walls of the chamber. Plasma current measurements showed that in general the current flowed within the limits of the inner region of the magnetic field (the region of the "crimped torus"). The current (along with the electric field) shorted out within 1 μsec. The plasma density varied not more than a factor of two during the heating stage when the temperature increased by a factor of 100. The experimental time of containment exceeded by an order of magnitude the calculated time of toroidal drift in the equipment. This retention time may be only the lower limit of the true retention time of the plasma. (TTT)

16774 MEASUREMENT OF PLASMA END LOSSES IN A Q MACHINE. Motley, R. W.; Jassby, D. L. (Princeton Univ., N. J.). Contract AT(30-1)-1238. Phys. Rev. Lett., 22: 333-5(Feb. 24, 1969).

The atomic flux resulting from cesium-ion recombination of the hot end plates of a Q device has been measured. The rate of ion loss to the end plates is found to be only a small fraction of the total loss rate, if the plasma potential is negative. (auth)

Diagnostics

Refer also to abstracts 16838, 16909, and 16912.

16775 (CEA-CONF–1204) NANOSECOND AXIAL SCHLIEREN PHOTOGRAPHY OF A PLASMA FOCUS. Baconnet, Jean-Pierre; Cesari, Georges; Coudeville, Alain; Watteau, Jean-Paul (Commissariat a l'Energie Atomique, Villeneuve-Saint-Georges (France)). [1968]. 8p. (In French). (CONF-681112–4). Dep.

From Annual Meeting of the Division of Plasma Physics, Miami Beach, Fla.

The plasma focus structure is studied axially by schlieren photography. A coaxial ϕ = 15-mm hole is drilled into the inner ϕ = 50-mm electrode and does not affect the plasma behavior and the neutron yield. Through this hole the beam of a 1-J, 15-ns ruby laser illuminates the plasma and is stopped by a metal disk of diameter ϕ_d in the focal plane of a 750-mm focal length lens. The plasma density gradients larger than a minimum value ranging from 5×10^{18} cm^{-4} (ϕ_d = 1.5 mm) to 2.5×10^{19} cm^{-4} (ϕ_d = 8 mm) are imaged on a 1-ns exposure-time framing camera. Schlieren photographs taken at different times are shown and compared with the luminous front. Before this front penetrates in the hole area, a heterogeneous transient plasma is detected. The plasma sheet is often asymmetric and shows quasi-circular stratifications. When the neutron emission starts (the detection threshold is 100 neutrons ns^{-1} in 4π steradians) a density gradient larger than 5×10^{18} cm^{-4} is observed on an 8-mm-diameter annulus. The luminous front reaches the axis 100 ns later. During collapse complex structures such as vortices are observed. (auth)

16776 (CEA-R–3359) STUDY OF A PULSED DISCHARGE IN HYDROGEN USING THE FAR ULTRAVIOLET EMISSION OF AN ADDITIONAL ELEMENT: ELECTRON TEMPERATURE MEASUREMENT. Schwob, Jean-Louis (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1968. 121p. (In French). (EUR–3569). Dep.

Thesis. Submitted to Univ. of Paris, France.

Ionization and excitation of an additional element in a pulsed annular discharge in hydrogen at low pressure (T.A. 2000) are described by means of a simple coronal-type analytical model. This model allows one to interpret the time variation of the intensity of spectral lines observed in the vacuum-ultraviolet region. From this analysis two methods of electron temperature determination are deduced. The first method is based on the apparition time measurement of the intensity maximum for the spectral lines emitted from successive ions of the additional element (nitrogen). In the second method the electron temperature is determined from the intensity ratio of two spectral lines of an alkali-like ion. The transition couples (2s–2p, 2s–3p) and (2s–2p, 3s–3p) of C IV, N V and O VI have been used. The results obtained with these two independent methods are in good agreement. The electron temperature varies from a few electron-volts at the beginning of the discharge, to 70 eV at the time of N V emission (at 55 μs), before the current maximum in the discharge (at 170 μs). (auth)

16777 (INR-P–948) SPECTRAL MEASUREMENTS OF PLASMA TEMPERATURE IN THE RPI INJECTOR. Suckewer, Szymon (Institute of Nuclear Research, Warsaw (Poland)). 1968. 39p. Dep.

The results of ion and electron temperature measurements for the focusing injector are shown in terms of initial conditions. The ion temperature measurements made with plasma being observed lengthwise and perpendicularly to the gun axis, thereby eliminating the correlated axial motion of plasma from the results. It was observed that T_i increases with a rise in ion charge, whereas increasing the initial gas pressure in the discharge tube decreases T_i. The ion temperature drop is also observed when applying an external magnetic field of 5 kG. The highest values of $T_i \approx 1.5 \times 10^6$°K are defined for the air initial pressure of 10^{-4} torr, and the maximum electron temperatures T_e do not exceed $\approx 5 \times 10^4$°K. The distribution of plasma ion and electron temperatures are determined as a function of distance from the gun axis. The considerable differences observed between the electron and the ion temperatures are also discussed. (auth)

16778 (N-68-32072) ANOMALOUS DIFFUSION IN A PLASMA FORMED FROM THE EXHAUST BEAM OF AN ELECTRON-BOMBARDMENT ION THRUSTER. Cohen, Allan J. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Aug. 1968. 30p. (NASA-TN-D-4758). CFSTI.

A 10-cm-diam. cylindrical anode with a grounded coaxial center rod was immersed in the low-density ($n_e \approx 2 \times 10^7$ cm^{-3}) exhaust beam of an ion thruster. A longitudinal magnetic field was applied. A theoretical and experimental study was made of the electron diffusion process in the beam plasma passing through the electrically floating anode. Anomalous diffusion and low-frequency noise were found. The mechanism of anomalous diffusion was considered similar to that reported by Kadomtsev and Nedospasov. Bohm's diffusion equation was found applicable and a constant of 1/8 (twice Bohm's value) was deduced experimentally. Rotation in the plasma was found by means of a correlation technique. The measured frequency of rotation ranged from 100 to 150 kHz. (auth) (STAR)

16779 (N-68-33838) DIAGNOSTICS AND INTERPRETATION OF ACCELERATION MECHANISMS IN AN MPD ARC. Brooks, D. R.; Hoell, J. M. Jr.; Hess, R. V.; Brockman, P. (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). [1967]. 31p. (NASA-TM-X-60478; CONF-670926-2). CFSTI.

From AIAA Joint Electric Propulsion and Plasmadynamics Conference, Colorado Springs, Colo.

Experimental results are presented for distributions of current, potential, electron density, electron pressure, and ion velocity vector orientation in a hollow-cathode porous-anode MPD arc. The presence of electromagnetic effects is verified by the existence of large radial electric fields and axial currents extending several anode diameters downstream from the electrodes. Additional evidence is provided by observation of the conversion of ion rotational velocity into translation. A relatively large azimuthal current of unknown magnitude and distribution has been found. Electrothermal fields ($\nabla P_e/ne$) can be as large as electric fields in some regions of the arc exhaust. Despite a large number of simplifications made in analysis, numerical solutions to Laplace's equation have yielded potential surveys which agree qualitatively with experiment. Computed equipotentials are given which show the effect of cathode location and magnetic field. (auth) (STAR)

16780 (N-68-34518) DIAGNOSTICS OF ACCELERATING PLASMA. Semiannual Progress Report, September 1, 1967-February 29, 1968. Lie, T. N.; Lee, K. F.; Chang, C. C. (Catholic Univ. of America, Washington, D. C. Dept. of Space Science and Applied Physics). Mar. 1, 1968. 44p. (NASA-CR-96774; SAPR-4). CFSTI.

The current sheet velocities in two groups of coaxial plasma accelerators, one using refractory and the other nonrefractory materials as insulators, are compared. A large difference in sheet velocity exists between the two groups in all cases, i.e., the velocities in the accelerators with nonrefractory insulators are slower. This is caused by the marked difference between the two groups of accelerators in the radial current carried by the current sheet. The impurity mass flow which follows the current sheet is observed particularly with the nonrefractory insulator. The results obtained here generally support the physical model on insulator ablation. The accelerators with refractory insulators and with clean systems also have a similar process and the sheet velocity is limited. In this case, however, degassing of light gas, e.g., hydrogen from the insulator wall, is probably responsible for the drag rather than ablation. The ablation problem is analyzed, mainly following Workman's results with the inclusion of an additional dimensionless parameter. Analysis and measurements show reasonable agreement over a wide area of accelerator operation. (auth) (STAR)

16781 (ORNL-tr-2068) ON THE THEORY OF CONDUCTIVITY OF ELECTROLYTES AND WEAKLY IONIZED PLASMAS. [PART] II. Kremp, D.; Kraft, W.-D.; Ebeling, W. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Ann. Phys. (Leipzig), (7) 18: 246-52(1966). 7p. Dep. CFSTI.

The original German article was abstracted as NSA 21: 18728. (M.H.R.)

16782 INVESTIGATION OF THE PLASMA PRODUCED BY A NORMAL IONIZING SHOCK WAVE USING POLYCHROMATOR TECHNIQUES. Brennan, M. H.; Fletcher, J.; Morrow, R.; Westwood, W. D. (Flinders Univ., Bedford Park, Australia). Aust. J. Phys., 22: 13-21(Feb. 1969).

Measurements of the electron density of a transient hydrogen plasma have been made by a study of the Stark broadening of the emitted Hβ radiation. The plasma is formed by the passage of a strong ionizing shock wave through a neutral gas in the pressure range $100 \leq p \leq 400$ mtorr. The instantaneous Stark-broadened line profiles have been constructed by simultaneously sampling the light intensities at a number of wavelengths within the Hβ line by the use of an eight-channel polychromator. It is shown that this approach yields information about the density and homogeneity of the plasma which is not available from laser interferometer measurements. Evidence is also presented which suggests that the ionizing shock waves presently obtained may have marked snowplough characteristics. (auth)

16783 FREQUENCY ANALYSIS OF THE PROBE CURRENT IN AN RF DISCHARGE. Sager, Otto (Swiss Federal Inst. of Tech., Zurich). Proc. IEEE (Inst. Elec. Electron. Eng.), 57: 227-8(Feb. 1969).

The harmonics of the probe current under the influence of a capacitively coupled disturbing voltage are discussed. From the ratio of two amplitudes the unknown rf voltage and the necessary correction of the direct current can be determined. (auth)

16784 MICROWAVE DETERMINATION OF ELECTRON DENSITY DISTRIBUTION IN A PLASMA. Basu, J.; Dutta C. (SINP, Calcutta). J. Inst. Telecommun. Eng., 11: 510-14(1965).

The electron density distribution in a cylindrical plasma with or without a static axial magnetic field is investigated in the case of the plasma placed coaxially in a microwave cavity by determining the resultant changes in the resonant frequencies of the cavity for different modes. The change in the resonant frequency has been calculated, using a perturbation theory, for each of the modes, TM_{010}, TM_{020}, TM_{110} and TM_{120}. This has been carried out in terms of the average electron density in the plasma for its different radii and for a number of typical density distributions. The frequency change, electron density and plasma radius are all given in suitable normalized forms so that the results are applicable in general. It is shown how these results can be used in practice for determining the electron density distribution. (auth)

16785 SPECTRAL TEMPERATURES OF NONUNIFORM PLASMAS. Gusinow, M. A.; Gerardo, J. B.; Hill, R. A. (Sandia Labs., Albuquerque, N. Mex.). J. Quant. Spectrosc. Radiative Transfer, 9: 383-9(Mar. 1969).

Boltzmann plots derived from spatially integrated spectral line intensities emitted from nonuniform gaseous plasmas are investigated. Emphasis is placed on the meaning of temperatures inferred from these Boltzmann plots and also on the effect of relaxing the LTE requirement. It is shown that for plasmas with sufficiently small electron density and electron temperature gradients the line-of-sight Boltzmann temperature is nearly equal to the spatially averaged electron temperature if sufficient LTE restrictions are applied. (auth) (UK)

16786 STARK BROADENING OF HYDROGEN BALMER LINES IN THE PRESENCE OF STRONG MAGNETIC FIELDS IN PLASMAS. Drawin, H. W.; Henning, H.; Herman, L.; Nguyen-hoe (EURATOM-CEA, Fontenay-aux-Roses, France. Laboratoire des Recherches Physiques, Paris). J. Quant. Spectrosc. Radiative Transfer, 9: 317-31(Mar. 1969).

The profiles of the Balmer H_α, H_β, H_γ and H_δ lines were measured for different electron densities N ($N = 3 \times 10^{15} \ldots 1 \times 10^{16}$ cm^{-3}) and for a magnetic field strength of H = 69 kgauss in the plasma region observed. The measurements showed a strong modification of the profiles of both the H_α and the H_β lines by the magnetic field when compared with profiles emitted from magnetically free plasmas. On the other hand, there was only a small influence of magnetic field on H_γ and H_δ. Concerning the H_α line, good agreement was found between the measured profiles and those calculated by Nguyen-Hoe, Drawin, and Herman. The conditions under which the wing intensities of ordinary Stark profiles may be used for a determination of electron densities, in spite of the presence of a strong magnetic field, were checked. A new method for measuring electron densities from line profiles in strongly magnetized plasmas is proposed. (auth)

16787 HOLOGRAPHIC INTERFEROMETRY WITH A DOUBLE-FLASH LASER. Buges, Jean-Claude; Piet, Annie; Terneaud, Alain (Centre d'Etudes de Limeil, Villeneuve-Saint-Georges, France). Compt. Rend., Ser. A, B, 267: 1271-4(Dec. 4, 1968). (In French).

The double flash of a ruby laser is used to obtain the interferogram of a plasma. (tr-auth)

Kinetics (General)

16788 (N-68-32550) PULSED ELECTROMAGNETIC GAS ACCELERATION. Semiannual Progress Report, January 1-June 30, 1968. Jahn, Robert G.; von Jaskowsky, Woldemar F. (Princeton Univ., N. J. Guggenheim Labs. for the Aerospace Propulsion Sciences). July 1, 1968. 89p. (NASA-CR-96227; SAPR-12). CFSTI.

Studies of the spontaneous transition of a parallel plate accelerator from a transient sweeping mode to a quasi-steady blowing mode have been extended to sufficiently long pulse times that the influence of externally injected mass flow can be clearly discerned. By Kerr cell photography of the downstream flow over a wedge, and by terminal voltage signatures, it is possible to distinguish situations of adequate mass flow injection, of mass starvation, and of mass overload of a given quasi-steady discharge configuration. A shock tube gas injection system for a high power magnetosplasmadynamic arc simulator has been devised which can provide mass flows up to 50 gm/sec of argon for three milliseconds, with a rise time of one millisecond. The feasibility of gas laser interferometric determination of electron density profiles through propagating current sheets has been established in a calibration experiment, encouraging application of this technique to the parallel plate and quasi-steady MPD accelerators. (auth) (STAR)

16789 INVESTIGATION ON A THETA-PINCH PLASMA NEAR THE PLASMA FREQUENCY. Gross, Daniel M. (Institut fuer Plasmaphysik, Garching, Ger.). Z. Phys., 221: 17-34(1969). (In German).

It is investigated to what extent the radiation of a thetatron plasma near the plasma frequency can be interpreted by means of bremsstrahlung emission. A new type of infrared scanning system allowing for radial resolution of the plasma radiation around 2.5 THz was designed for this purpose. The radiation intensities measured herewith are compared with the results of a computer program. This program based on an experimentally verified hydromagnetic model gives the time-dependent bremsstrahlung intensity in a ray optical approximation; supplementary computations have been carried out in wave optical approximations. The results of both calculations are in good agreement with the infrared measurements except for a short radiation peak during the first shock wave phase of the discharge. This peak can be interpreted, however, by means of a semiquantitative evaluation as a two-stream instability-induced radiation burst. (auth)

16790 STRIATIONS. Nedospasov, A. V. Usp. Fiz. Nauk, 94: 439-62(Mar. 1968). (In Russian).

This review article is devoted to stratified gas discharges and covers essentially research performed during the last 15 years. The main experimental data on striations, both spontaneous and artificially produced, are presented. Different hypotheses explaining the stratification of the homogeneous discharge column are analyzed. A theory is presented for striations of small and large amplitude, interpreted as oscillations of ionization–diffusion character. This theory makes it possible to explain all the well-known laws governing these striations: the similarity laws, the existence limits, the magnitude and sign of the velocity, the dispersion relations, the influence of the magnetic field, etc. A new phenomenon, the so-called magnetic striations, is described. A weakly ionized plasma in crossed electric and magnetic fields is unstable, and this instability has an ionization character. A theory of this phenomenon and its experimental confirmation are presented. (ATD)

16791 IONIZATION WAVE (STRIATIONS) IN A DISCHARGE PLASMA. Pekarek, L. (Inst. of Physics, Prague). Usp. Fiz. Nauk, 94: 463-500(Mar. 1968). (In Russian).

The stratification of the positive column of a discharge in a gas is shown to be due to the propagation of the unique waves, presently called ionization waves. An investigation of artificially produced small-amplitude ionization waves in a plasma whose parameters are that the waves are not excited spontaneously has revealed that these waves have a great variety of dispersion properties, manifest in the fact that backward waves, forward waves flowing from the anode to the cathode, and different intermediate types are observed. They frequently have convective instability and sometimes also absolute instability. The propagation of ionization waves is due to a unique closed circuit for the processes, the localized perturbation of the homogeneity of the plasma gives rise to a space charge, and the electric field produced by this space charge changes the average energy of the electrons in such a way that the ionization decreases on the anode side of the increased ion concentration. The process repeats with alternating sign and leads to the propagation of a unique wave described by an equation that contains only the first derivative with respect to the time. The experimentally obtained properties of the ionization waves are described and a physical explanation for them is presented. (ATD)

16792 IMPROVEMENTS IN HOMOPOLAR GENERATORS. Rebut, Paul Henri; Torossian, Antoine (to Commissariat a l'Energie Atomique). British Patent 1,143,649. Feb. 26, 1969. Priority date Nov. 26, 1965, France.

The main feature of this generator is the incorporation of a high power step-up transformer with its magnetic circuit in the stator. Detailed drawings are given. (M.O.W.)

Kinetics (Experimental)

16793 (LA–3994) PLASMA STREAM INTERACTIONS THROUGH POLARIZATION ELECTRIC FIELDS. Hammel, Jay E.; Kewish, Ralph W. Jr. (Los Alamos Scientific Lab., N. Mex.). Apr. 1968. Contract W-7405-eng-36. 6p. Dep. CFSTI.

An experiment using two plasma streams with opposing velocities in a transverse magnetic field to observe the interaction of the two opposing polarization electron fields is briefly described. The technique is a possible means of loading a closed-field geometry. The two similar streams are not directly opposed but are displayed from one another along the magnetic field to increase the possibility of a significant interaction. The fast plasma produced by coaxial guns has a density up to 5×10^{14} cm^{-3} and a directed velocity of 50 to 70 cm/μsec. The resultant polarization field in kilogauss magnetic fields is of the order of kV/cm. The lateral stream separation is 54 cm, and at magnetic fields below 3.0 kG the streams have a negligible effect on each other. At high fields (7.0 kG), the streams have a larger interaction under certain conditions, and an increase in density is observed. The effects when the two streams differ widely in density and arrival time are discussed. (auth)

16794 DEVELOPMENT OF THE DISCHARGE PLASMA IN A HYDROGEN SPARK AT SMALL pd VALUES. Meyer, J. (Univ. of British Columbia, Vancouver). J. Phys., D (London), 2: 221-8(Feb. 1969).

The development of plasma parameters in a spark discharge was studied using spectroscopic techniques. It was observed that a transition from a molecular glow discharge to a fully ionized arc channel plasma place in the discharge column after initiation of a radial shock wave. The transition from a γ_{ion} process to a cathode spot mechanism initiated an axial shock wave of Mach number M = 1.38 moving through the fully ionized channel from cathode towards anode. (auth) (UK)

16795 IONIZATION AND ATTACHMENT IN OXYGEN AT LOW PRESSURES. Thomas-Betts, Anna; Davies, D. E. (Univ. of Keele, Eng.). J. Phys., D (London), 2: 213-21(Feb. 1969).

From measurements of pre-breakdown currents across plane-parallel electrodes, and with the aid of a simple analysis ionization and attachment coefficients were evaluated for $50 < E/p_0 < 250$ v cm^{-1} torr^{-1}. Values of the attachment coefficient were found to reduce to practically zero at about 70 V cm^{-1} torr^{-1}, which could indicate a detachment process. Sparking potentials were also measured in the range $0.1 < p_0d < 5$ cm torr, and this enabled the evaluation of generalized secondary coefficients. (auth) (UK)

16796 CUT-OFF OF CYCLOTRON HARMONICS AND PLASMA INSTABILITY. Patrushev, B. I.; Gozak, V. P.; Frank-Kamenetskii, D. A. Zh. Eksp. Teor. Fiz., 56: 99-103(Jan. 1969). (In Russian).

A sharp increase of energy losses with subsequent emission of microwave radiation whose frequencies were harmonics of the cyclotron frequency was observed during cyclotron heating of the plasma electrons. The phenomena were observed at certain plasma concentrations which were close to cutoff conditions (vanishing of the refractive index) for the respective harmonics. It is suggested that they can be explained by trapping of the waves induced by anisotropic instability within the reflecting layer. The possibility of applying the same mechanism to other cases of double resonance in the plasma is discussed. (auth)

16797 EXCITATION OF ACOUSTIC WAVES IN A CO_2 DISCHARGE PLASMA. Exner, V. L.; Pekarek, L. (Inst. of Physics, Prague). Appl. Phys. Lett., 14: 37-8(Jan. 1, 1969).

A relatively slight voltage pulse disturbance produces an acoustic wave in a CO_2 dc discharge. The amplitude is so large that indirect indication by means of changed light intensity in the column is possible. An explanation of high efficiency of excitation is proposed in terms of dissociation of CO_2 molecules. (auth)

16798 EXPERIMENTAL INVESTIGATION OF THE INFLUENCE OF THE WALL SPACE-CHARGE SHEATH ON EXTRACTION OF POSITIVE IONS. Broemer, H. H.; Hesse, J. (Technische Univ., Brunswick). Z. Naturforsch., 23a: 1960-7(Dec. 1968). (In German).

The mechanism of ion extraction from a weakly ionized plasma has been investigated using a quadrupole mass spectrometer. The plasma was generated in a flow system by means of a high-frequency discharge. It could be shown that the picture given by Pahl has to be extended by considering a space charge sheath spread over several mean free ion paths in front of the plane ex-

traction probe, used. Two effects, resulting from the space charge, have been found observing the behavior of nitrogen ions. First, the directional distribution of the extracted ions may be different for different ions. Second, ion–molecule reactions may be caused by the field strength within the sheath varying with both ion number density and probe voltage. In the case of N_4^+ ions the Varney reaction seems already to start in the static sheath. In order to minimize influences from the space charge, it is suitable to apply a slightly positive potential with respect to the container wall. (auth)

16799 ELECTRIC CONDUCTIVITY OF PLASMA AHEAD OF AND BEHIND SHOCK WAVES. Rothhardt, L. Pr. Inst. Masz. Przeply., No. 34, 141-7(1967). (In German).

A description and explanation is given of an electrodynamic, electrodeless device for the generation of fast-moving currentless plasma bunches, i.e., of an inductive hydrodynamic shock tube. Further, the measurements of flowing plasma conductivity between cold electrodes are described. The associated phenomena in these measurements may easily be defined and interpreted for the measurements of "longitudinal conductivity." During the measurements taken perpendicular to the flow, boundary-layer phenomena occur, which are also explainable by measuring the distribution of the potential with current passing between electrodes. (auth) (App. Mech. Rev.)

16800 INVESTIGATIONS OF THE AFTERGLOWS OF PULSED RARE-GAS DISCHARGES IN THE FREQUENCY RANGE 200 TO 1500 MHz. Dutt, T. L. (Northern Polytechnic, London). J. Phys., B (London), 2: 234-47(Feb. 1969).

An investigation was made into the dielectric properties of rare-gas afterglow plasmas under varying conditions of pulsed-discharge excitation in the pressure range 0.1 to 5 torr. Measurements were carried out in the frequency range 200 to 1500 MHz using a circular cylindrical cavity energized in the TM_{0m0} family of modes, the signal frequency increasing as m is increased. A study was made of the way in which the change in the cavity resonant radian signal frequency at a given time in the afterglow, $(\Delta\omega)_t$, varies with m. Two kinds of afterglow were distinguished from experiment: those for which $(\Delta\omega)_t$ increases with increase in m, for example the afterglows following pulsed thermionic arc discharges, and those for which the sense of change of $(\Delta\omega)_t$ with m is reversed, for example afterglows following long-pulse (~11 ms), relatively low-power, radiofrequency discharges. At low pressures, and for a specific signal frequency, the second kind of afterglow causes the cavity to resonate at two different times during the decay; this does not happen with the first kind. Associated with the second kind are greatly increased afterglow decay rates, which are dependent on the current pulse width δ. A changeover from the first to the second kind of afterglow is observed in xenon when the radiofrequency current pulse width is increased in the range 10 μs to 2 ms at fixed input power, or when the input power is increased in the range from about 200 w peak to about 1 kw peak at fixed δ. The phenomena are interpreted in terms of afterglows populated mainly by a free-electron gas (first kind), or mainly by a quasi-bound electron gas (second kind), or by a combined population of both gases (changeover régime). Measurements enable the plasma frequency and collision frequency for momentum transfer with neutral atoms to be determined for both kinds of afterglow and, in addition, determinations to be made of the internal frequency of oscillation of the quasi-bound electrons, yielding values for this parameter in the range 6×10^8 to 8×10^9 Rad s^{-1}. (auth) (UK)

16801 ARC PHENOMENA AND GASDYNAMIC EFFECTS DUE TO INTERACTION OF SHOCK WAVES WITH MAGNETIC FIELDS. Klingenberg, H. (Institut fuer Plasmaphysik, Munich). Z. Naturforsch., 23a: 1929-39(Dec. 1968).

The arc phenomena occurring on interaction of shock-heated plasma with a magnetic field were studied in order to achieve an approximately uniform current distribution in a certain volume using a number of small electrodes. This is necessary for producing plane gasdynamical effects such as reflected shocks and one-dimensional flow behind them in order to compare experimental results with theory. The current amplitude depends on the surface area and the number of electrodes. It is governed by the complex boundary conditions in the plasma-to-electrode transition, which consists of narrow current channels leading to arc spots. Streak photographs show that the flow is slowed down, and reflected fronts are observed which can be interpreted as shock fronts taking relaxation effects into account. (auth)

16802 FORMATION OF MOLECULAR HELIUM DURING THE EARLY AFTERGLOW. Gusinow, M. A.; Gerardo, J. B. (Sandia Labs., Albuquerque, N. Mex.). Phys. Rev., 180: 96-103(Apr. 5, 1969).

It is shown that in the early afterglow, of a somewhat typical helium plasma, molecular excited-state densities develop pronounced spatial gradients. This study emphasizes the physics of the formation and maintenance of the observed molecular nonuniformities. Two models are proposed in an attempt to explain the phenomenon. One is a collisional-equilibrium model and the other is a nonuniform-formation model. (auth)

16803 BREMSSTRAHLUNG AND RECOMBINATION RADIATION OF NEUTRAL AND IONIZED NITROGEN. Morris, J. C.; Krey, R. U.; Garrison, R. L. (Avco Corp., Wilmington, Mass.). Phys. Rev., 180: 167-83(Apr. 5, 1969).

Continuum radiation measurements are presented for nitrogen over a spectral range from 975 to 37,000 Å for temperatures ranging from 9000 to 13,500°K and 1- and 2-atm pressure. The measurements were made using a plasma produced in a dc mechanically constricted arc generator. The data are separated by a temperature-dependence curve fit into the contributions from positive-ion and neutral-atom radiation. The N^+ radiation is compared to an analytical calculation based on the Burgess and Seaton quantum-defect method for the free bound and on the Gaunt factors of Karzas and Latter for the free–free processes. The remaining radiation in the visible and infrared is ascribed to the neutral atom. This data are analyzed to derive the N^- species responsible for the recombination radiation and to extract its ionization energy from the position of observed absorption edges. A value for the $(N^{-1}D)$ negative-ion cross section is obtained. Extraction of the neutral atom Z^2g factor for the bremsstrahlung process was made from the continuum data in the infrared. Comparison is also made to other experimental data. (auth)

16804 EXPERIMENTAL EVIDENCE FOR A SIMILARITY RELATION IN IONIZATION WAVES. Sicha, M.; Drouet, M. G. (Univ. of Montreal). Beitr. Plasmaphys., 8: 403-4(1968).

Measurements in a neon discharge are presented which suggest the existence of a similarity relation between the values of EA, pD and i/D for the ionization waves of type "p" in a plasma. (auth)

16805 ACCELERATION OF A PLASMA BY ITS OWN RADIATION. Gudzenko, L. I.; Moroz, E. M. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.), 8: 265-7(Oct. 20, 1968).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 8: 430-2(Oct. 20, 1968).

If the radiation of a plasma is anisotropic, the photon yield from the plasmoid is accompanied by a thrust due to amplification of the radiation. The case of a highly ionized plasma with inverted population and deep cooling is considered, and estimates of the plasmoid acceleration a^0 are obtained: H, $a_H^0 \simeq 2 \times 10^6$ cm/sec^2; H-like ions of atomic number Z, $a_Z^0 \simeq Z^5 a_H^0$; and Li, $a_{Li}^0 \simeq 6 \times 10^7$ cm/sec^2. (D.L.C.)

Kinetics (Theoretical)

16806 (CEA-CONF-1005) STUDY OF PROPERTIES OF THIN-β TOROIDAL PLASMAS. Adam, Jean-Claude; Mercier, Claude (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [nd]. 16p. (In French). (CN-24/B-3; CONF-680805-24). Dep.

From 3rd International Conference on Controlled and Plasma Physics, Novosibirsk, USSR.

Plane closed configurations, in which the rotational transformation is due to the longitudinal current, were studied. The results are particularly applicable to apparatus of the Tokamak and Harmonica type. The general properties of the equilibria with a single magnetic axis in the vicinity of $(ic/2\pi)_0 = k$ were first studied. The MHD stability of these equilibria was then studied. Some plasma models with more complex topology are presented. (J.S.R.)

16807 (CEA-R-3615) USE OF A MONTE-CARLO METHOD FOR STUDYING THE STATISTICAL DISTRIBUTION OF ELECTRIC FIELDS AROUND AN ION IN A ONE-COMPONENT PLASMA. Rossignol-Guzzi, Daniel (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes Nucleaires). Nov. 1968. 104p. (In French). Dep.

Thesis. Submitted to Univ., Paris.

A Monte Carlo simulation has been made of the equilibrium configurations taken by a plasma of equally charged prompt ions, immersed in a uniform neutralizing background of electrons. The statistical repartition of the electric field acting on one ion, needed to obtain the Stark effect, was specially obtained. Comparison for dense plasmas was made with the former works of Holtzmark, Mayer, and Broyles. (auth)

16808 (N-68-31436) STRUCTURE OF MAGNETOHYDRODYNAMIC SHOCK WAVE. Liu, Chung Kung (Catholic Univ. of America, Washington, D. C. Dept. of Space Science and Applied Physics). June 1967. 65p. (NASA-CR-95956). CFSTI.

The structure of the plane magnetohydrodynamic shock wave of

a rarefied, fully ionized plasma was studied. Both the shock front and the magnetic field were assumed to be perpendicular to the flow direction. In the undisturbed region, the gas pressure (= nkT) can be comparable to, much smaller, or much larger than the magnetic pressure (= $B^2/8\pi$), and also the magnetohydrodynamic Mach number (M*) can be any value greater than unity. Since the plasma is so rarefied that the mean free path here cannot be considered as a relevant scale length for the shock thickness, instead the geometrical mean of the ion and electron Larmor radius is the appropriate one. Under these assumptions, the structure of large M* shock wave is solitary wave-like, and that of the smaller M* shock waves can be either oscillatory or monotonic depending on the value of electrical resistivity. (auth)(STAR)

16809 (N-68-32069) QUANTUM THEORY OF AN ELECTRON GAS WITH ANOMALOUS MAGNETIC MOMENTS IN INTENSE MAGNETIC FIELDS. Chiu, Hong-Yee; Canuto, Vittorio; Fassio-Gunuto, Laura (National Aeronautics and Space Administration, New York. Goddard Inst. for Space Studies). [1968]. 18p. (NASA-TM-X-61035). CFSTI.

Expressions are obtained for the thermodynamic energy density, particle density, the magnetic moment, and pair density (created in equilibrium with the system) for a gas of electrons with an anomalous magnetic moment, using the exact eigenvalues of the Dirac-Pauli equation for an electron with an anomalous magnetic moment, obtained by Ternov. According to the solution of Ternov, the lowest energy states of the electrons can be zero at certain field strengths. It is shown that pair creation does not occur spontaneously at the expense of thermodynamic energy of other particles of the system. Exact expressions for the pair density are given. (auth) (STAR)

16810 (N-68-33899) SPECTRAL DISTRIBUTIONS OF TURBULENCE IN A PLASMA WITH COLLISIONAL AND COLLISIONLESS DISSIPATIONS. Tchen, C. M. (National Bureau of Standards, Washington, D. C.). [1967]. 47p. (NASA-CR-87760; CONF-670810-9). CFSTI.

From 8th International Conference on Phenomena in Ionized Gases, Vienna, Austria.

Based on the Navier-Stokes equation of motion, the equation of continuity for a compressible fluid, and the Poisson equation for charge densities, this study deals with the spectral distributions of turbulent energy and density fluctuations in a plasma with a strong magnetic field. Collision-dominated and collisionless plasmas are considered. The nonlinear equations are solved by the use of a cascade decomposition. The dissipation necessary for a modal transfer to prevail in the direction from big eddies to smaller ones is represented by the viscosity in a collision dominated plasma. However, in a collisionless plasma, the above molecular dissipation does not exist, and its role is replaced by a collisionless dissipation, caused by the electrostatic correlations. The formula of diffusion derived here confirms the Bohm formula with a large numerical coefficient. The study emphasizes a plasma where the electron temperature far exceeds the ion temperature, and the wave length of the turbulent motion exceeds the Debye length. However, the reduced system of fundamental equations, from which the spectra are derived are analogous to that governing gravity turbulence in atmosphere and ocean with a Coriolis force. This suggests that the method and some of the results may be applicable to such problems too. (auth) (STAR)

16811 (SC-R-68-3907) ON THE REFLECTION COEFFICIENT OF A PLASMA PROFILE OF EXPONENTIALLY TAPERED ELECTRON DENSITY AND FIXED COLLISION FREQUENCY. Harrison, Charles W. Jr.; Jones, Rondall E. (Sandia Labs., Albuquerque, N. Mex.). Nov. 13, 1968. 6p. Dep. CFSTI.

The reflection coefficient (ratio of reflected to incident electric fields) is found at an arbitrary point within a plasma profile of exponentially tapered electron density and fixed collision frequency. To facilitate the analytical solution of the problem it is found advantageous to terminate the profile in a perfectly conducting plate. This artifice has little physical significance if the plate is positioned in the region of reflection where the electromagnetic field is negligible. But there is some indeterminancy in locating this region. In the present analysis the plate is located at the level of electron density where the magnitude of the complex relative dielectric constant passes through a minimum or where the real dielectric constant goes through zero since, in the region of these points, the electromagnetic field is evanescent. Reflection factors for both plate locations are computed and compared. Evidently when the plate is positioned at the lower electron density the magnitude of the reflection coefficient is larger, so that an upper bound on the size of the coefficient is established. (auth)

16812 EVIDENCE OF TRAPPED-PARTICLE MODES IN LOW-β PLASMAS. Coppi, B. (Inst. for Advanced Study, Princeton, N. J.). Phys. Lett., 28A: 518-19(Jan. 13, 1969).

It is proposed that fluctuations observed in multipole configurations are experimental evidence of "trapped-particle modes" having the proper phase velocity, frequency, and topology, and that these provide a mechanism for anomalous particle loss in conditions where fluctuations are absent. (auth)

16813 KINETICS OF PLASMA IN A UNIFORM ELECTRIC FIELD. Davidson, R. (Univ. Libre, Brussels). Physica, 38: 587-607(June 5, 1968).

A formalism is presented for studying the nonequilibrium statistical mechanics of a one-component plasma in the presence of an external electric field, based on the works of Prigogine and collaborators at Brussels. The author begins with the Liouville equation for a system of N identical particles of mass m, such that the position and velocity of the j-th particle are x_j and v_j, respectively, where the external force on the j-th particle is $mF_j(x_j, v_j, t)$ (t = time) and where the particles interact via a central two-body force derivable from a potential e^2V_{jn} for the force between particles j and n. The operator on the (x,v) space of the equation becomes diagonal when a Fourier transformation of the x dependence is done; it is then shown that a mathematically identical situation can arise, in general, if a certain canonical change of phase-space variables is performed. Boundary conditions are next imposed on f_N, rather different from the usual, so as to specify the problem, and their effects on the Fourier transform coefficients in terms of the new variables are derived. Finally, explicit kinetic equations are produced from the formalism, including the Vlasov equation and ring equations. (L.M.T.)

16814 INTERACTION OF ATOMS WITH ELECTRONS OR IONS IN A PLASMA. Likal'ter, A. A. Zh. Eksp. Teor. Fiz., 56: 240-5(Jan. 1969). (In Russian).

The contribution of dipole and quadrupole interaction of atoms with electrons and ions to the thermodynamic potential of a plasma is calculated. The expression obtained is employed for evaluation of the ionization energy decrease of negative ions. (auth)

16815 EXTRACTION OF IONS FROM A RADIO-FREQUENCY DISCHARGE. Carter, R. G.; Newton, R. H. C. (University Coll. of North Wales, Bangor). J. Phys., D (London), 2: 241-50(Feb. 1969).

The extraction of ions from the plasma of a gas discharge and their formation into a beam is investigated theoretically. The results are shown to be applicable to a gridded ion gun. The results are also applicable to the design of canal extraction systems. The theory is compared with the results of experiments and some agreement is found for sufficiently high accelerating voltages. The discrepancy is believed to be the result of the partial neutralization of the beam by secondary electrons in the experiments. (auth) (UK)

16816 NUMERICAL CALCULATIONS FOR AXIALLY SYMMETRIC WALL-STABILIZED ARCS. Nagel, S.; Druxes, H.; Schmitz, G. (Technische Hochschule, Aachen). Z. Phys., 220: 362-80(1969). (In German).

A method is outlined which gives a numerical description for some configurations of axially symmetrical constricted electric arcs. For this purpose the equations of a single-fluid model of plasma physics are decoupled in such a was that only the heat flux potential, the axial velocity, the radial velocity, the average axial pressure gradient, and the average axial electric field have to be calculated simultaneously, considering a given set of boundary conditions. The method is applied to the Koppelmann arc. Some experiences in applying this method to the computation of further arc configurations are presented. (auth)

16817 FIRST-ORDER PHASE TRANSITIONS IN QUANTUM-COULOMB PLASMAS. Carmi, Gideon (Yeshiva Univ., New York). J. Math. Phys. (N. Y.), 9: 2120-31(Dec. 1968).

A simplified model is suggested for the understanding (in principle) of the mechanism of a phase transition in a Coulomb system on a uniform neutralizing background. Quantum theory is taken into account only in so far as it provides discrete collective energy levels and, possibly, fermion statistics for the calculation of the collective modes. Other features stemming from the uncertainty relations are supposed to be irrelevant to the mechanism of the phase transition. This procedure provides an "effective quantum Hamiltonian" H_{qu}, which incorporates the relevant quantum features and from which one can calculate the (approximate) quantum partition function using classical methods. In the evaluation of this integral one uses the same approximation in which the plasma modes are collective, viz., the RPA (random phase approximation). Because of the freezing-out of the collective degrees of freedom at the relevant temperatures, and because the number of these degrees of freedom changes with temperature and density, H_{qu} describes a system with variable degrees of

freedom, which seems to provide the mechanism for the phase transition. Preliminary numerical evaluations indicate a phase transition at $T = 0$ for an electron plasma at $r_s = 7.6$, i.e., just below the region of metallic densities. This is shown by finding a concave region in the free energy as a function of the density. The ground is then prepared for numerical evaluation of the transition at $T \neq 0$. For white dwarfs a transition temperature of $10^7 \sim K^\circ$ was found. (auth)

16818 VARIATIONAL SOLUTIONS OF NONLINEAR POISSON–BOLTZMANN BOUNDARY-VALUE PROBLEMS. Anderson, N.; Arthurs, A. M. (Univ. of York, Heslington, Eng.). J. Math. Phys. (N. Y.), 9: 2037-8(Dec. 1968).

Variational solutions of one-dimensional nonlinear Poisson–Boltzmann boundary-value problems in the theory of colloids and plasmas are obtained. The accuracy of the solutions is measured in terms of upper and lower bounds for the field energy which result from complementary variational principles. (auth)

16819 EQUATION OF STATE AND SAHA EQUATION OF PARTIALLY IONIZED PLASMAS. Ebeling, W. (Univ., Rostock, Ger.). Physica, 38: 378-88(May 1, 1968).

On the basis of a generalization of the method by Uhlenbeck, Beth, and Kahn to quantum plasmas, given in recent papers, the thermodynamic properties of plasmas are investigated. Using a semiclassical approximation, the free energy of low-density plasmas at temperatures below a rydberg is derived. The lower-bound energy states ($E_n \lesssim -kT$) are treated quantum mechanically and the higher states ($E \gtrsim -kT$) are described classically. An expression for the pressure of the plasma is obtained. From this a Saha equation is derived. Convergent expressions are given for the constant of the mass action law and the atomic partition function which depend only on the temperature. (auth)

16820 UNSTABLE PLASMA IN THE RING APPROXIMATION. Grecos, A. P. (Univ. Libre, Brussels). Physica, 38: 312-16 (Apr. 5, 1968).

It is pointed out that the kinetic equation for an unstable plasma, in the ring approximation, conserves momentum and energy. The connection with the wave–particle interaction theory is given. (auth)

16821 INTERACTIONS IN A CLASSICAL RELATIVISTIC PLASMA. Baus, M. pp 351-424 of Topics in Nonlinear Physics. Zabusky, Norman J. (ed.). New York, Springer-Verlag New York, Inc., 1968.

Discussions are given on the following: (1) Lorentz-invariant statistical mechanical formalism for a classical relativistic plasma interacting with an electromagnetic field, (2) electrodynamics of plasmas, (3) kinetic approach to the electrodynamics of homogeneous systems, and (4) kinetic approach to phenomenological radiation laws for homogeneous systems. (M.O.W.)

16822 ELECTRON-IMPACT BROADENING OF ISOLATED LINES OF NEUTRAL ATOMS IN A PLASMA. I. Cooper, J. (Univ. of Colorado, Boulder). Phys. Rev., 180: 286-98(Apr. 5, 1969).

The generalized impact theory for electron broadening of isolated spectral lines emitted by neutral atoms in a plasma is considered. The existing theory is improved by quantitative evaluation of the second-order (quadrupole) term in the multipole expansion including broadening of the lower level and interference effects, by approximate inclusion of the "back reaction" of atom on perturber in inelastic collisions through symmetrization with respect to initial and final perturber states, and by corrections to the broadening functions in the classical-path approximation. While the quadrupole contribution is normally a small correction, it is shown that it may, in principle, dominate the weak collision broadening in some situations even when the multipole series converges; however, strong collisions will always dominate in this case. Numerical results of the improved theory are given for the half-widths at half-maximum of some helium I lines, and the effects of the corrections are evaluated. (auth)

16823 KINETIC-ENERGY CORRECTIONS TO KLEIN'S THEOREM FOR THE THERMODYNAMIC FUNCTIONS OF A PLASMA. Theimer, O.; Wright, T. (New Mexico State Univ., Las Cruces). Phys. Rev., 180: 308-14(Apr. 5, 1969).

It is shown that the average thermal energy of a system of N free electrons and N free protons with density $n = N/V$ and temperature T has the form $E = 2N\,[\frac{3}{2}kT + Tf(\eta) + f_1(n,T) + f_2(n,T)]$, where f, the leading term in the electrostatic energy, is an arbitrary function of $\eta = Tn^{-\frac{1}{3}}$ in agreement with the original Klein theorem. f_1 is a kinetic-energy correction which is related to the electrostatic energy f_2 by the differential equation $-n/T\,\partial/\partial n\,(f_1 + f_2)_T = T/3\,\partial/\partial T\,(2f_1 + f_2/T)_n$. Some consequences of this result are discussed. (auth)

16824 ELECTRICAL PROPERTIES OF A HOMOGENEOUS, MAGNETICALLY ACTIVE PLASMA. Machalski, Krzysztof Jerzy (Polytechnical Inst., Lodz, Poland). Zesz. Nauk. Politech. Lodz., Elek., No. 23, 5-18(1967). (In Polish).

This work shows that the particle orbit method applied to the case of an anisotropic plasma situated in a constant magnetic field gives correct results which are in accord with those obtained by solving Boltzmann's kinetic equation. Attention is concentrated on a homogeneous center of free electrons penetrated by microwaves. The electron center is moreover located in a constant external magnetic field. A complex tensor of electron gas conductivity is derived from simple physical considerations. By means of 29 equations the author develops the concordant results and in a supplement he presents a solution involving circularly polarized vectors, as suggested by the symmetry of the equations used to determine electron velocity. An approximation is employed avoiding certain expressions and higher powers. An illustration of the results for weak fields is that the time between electron collisions must be no more than 10^{-7} sec. Under the conditions of interstellar space the thus computed time would have to be no more than 10^{-2} sec. For the fields existing in the solar corona the time needed for transition of the free electron path must be less than 10^{-11} sec. (JPRS)

16825 FREE-FALL DECAY OF A MERCURY VAPOR PLASMA IN THE EARLY AFTERGLOW. Gregory, B. C. (Trent Univ., Peterborough, Can.). Phys. Rev. Lett., 22: 335-8(Feb. 24, 1969).

A free-fall theory is developed for the decay of the average electron number density and of the electron temperature in a pulsed cylindrical mercury vapor discharge plasma using moment equations for the ions with a collision term for momentum loss, and assuming Maxwellian electrons. The plasma assumption was used. Good agreement is obtained with experimental results on four tubes of varying diameter. (auth)

16826 DIELECTRIC CONSTANT IN THE HARTREE–FOCK APPROXIMATION. Dekeyser, R. (Instituut voor Teoretische Fysika, Louvain, Belg.). Physica, 38: 189-204(Apr. 5, 1968).

Hartree–Fock corrections for the Boltzmann–Vlasov equation are derived in RPA from the Wigner distribution function in second quantization, and applications are made to the dielectric constant of an electron gas. From this, the screening length of a degenerate electron gas is reduced by about 35%. (auth)

Production

16827 PRODUCTION OF THIN SOLID-HYDROGEN FOILS FOR USE AS TARGETS IN HIGH VACUUM. Sigel, R.; Krause, H.; Witkowski, S. (Institut fuer Plasmaphysik, GmbH, Garching, Ger.). J. Phys., E (London), 2: 187-90(Feb. 1969).

Thin solid-hydrogen disks with a lifetime of about 10 min were produced by freezing a liquid-hydrogen film spread over a hole in a liquid-helium-cooled condensation plate. The transparent self-supporting disks had a diameter of 2 mm, and they diminished in thickness from initially about 1 mm to zero as a result of slow vaporization. The method described enables materials which are gaseous under normal conditions to be produced as solid foils in high vacuum. This can be done in quick succession by means of the simple apparatus described. Such foils can be used, for example, as targets for producing plasma by laser light. (auth) (UK)

16828 IONIZATION COEFFICIENTS IN NITROGEN CONTAINING RADIOACTIVE IMPURITIES. Jones, J. (University Coll. of Swansea, Wales). J. Phys., D (London), 2: 205-13 (Feb. 1969).

Values of the Townsend coefficients α and ω/α were obtained over the range $100 < E/p_0 < 510$ cm^{-1} torr^{-1} for contaminated nitrogen samples; the contaminants used were the radioactive isotopes tritium and krypton-85. Two impurity concentrations were used for each contaminant: 6 μCi cm^{-3} and 60 μCi cm^{-3} respectively. Values obtained for the primary coefficients in these contaminated samples were significantly higher than those in pure nitrogen. This increase in α/p was attributed to the preferential ionization of long-lived metastable states of nitrogen, which were produced by the decay radiations of the included isotopes. This conclusion was supported by the breakdown of the similarity principle found to occur for Paschen curves. No significant difference in the secondary coefficients for the pure and contaminated nitrogen was observed. (auth) (UK)

Stability

Refer also to abstract 16836.

16829 (CEA-CONF-1006) STUDY OF MICROINSTABILITIES IN A PLASMA OF CONFINED HOT ELECTRONS. Jacquinot, J.; Leloup, C.; Poffe, J. P.; de Pretis, M.; Waelbroeck, F.; Evrard, P.; Ripault, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1968]. 14p. (In French). (CN-24/H-11; CONF-680805-29). Dep.

From 3rd International Conference on Controlled and Plasma Physics, Novosibirsk, USSR.

Several types of microinstabilities appear in plasmas composed principally of hot electrons heated by pulse heating. One of these instabilities modifies the distribution function of the velocities in the confined space. The observations obtained to the present on this instability is compatible with the predictions of a linear theory of the amplification of the electromagnetic waves in a plasma with anisotropic pressure. This theory was generalized to take account of the presence of a significant density of cold plasma. The experimental device is described and the characteristics of the plasma after heating are given. (J.S.R.)

16830 (CEA-CONF-1008) NONLINEAR INSTABILITIES IN INHOMOGENEOUS PLASMA. Coppi, B. (Institute for Advanced Study, Princeton, N. J.); Laval, G.; Pellat, R. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). [Centre d'Etudes Nucleaires]); Khiet, Tu (Paris Univ., Orsay (France). Laboratoire de Physique des Plasmas). [1968]. 17p. (In French). (CN-24/E-14; CONF-680805-27). Dep.

From 3rd International Conference on Controlled and Plasma Physics, Novosibirsk, USSR.

When the shearing of the lines of force of a plasma is sufficient to suppress the unstable modes, the plasma can remain locally unstable and can amplify the wave bundles: other stability criteria are then obtained by imposing the restriction that this amplification does not exceed a certain number n_0 of exponentiations. The determination of n_0 is the object of the present study. The stabilizing role of shearing on the localized modes is made precise by calculating explicitly the growth rate of the modes. In the case where the stabilization criteria of the modes is satisfied, the propagation and amplification of the convective modes excited by the thermal fluctuation of the plasma are analyzed. It is shown that a nonlinear reflection mechanism of wave bundles permits a nonlinear instability to be triggered. The same conclusion is obtained by the analysis of a nonlinear instability due to resonating coupling of derivative waves having energy of different signs. (tr-auth)

16831 (MATT-Trans-63) STOCHASTIC INSTABILITY OF TRAPPED PARTICLES AND CONDITIONS FOR APPLICABILITY OF THE QUASILINEAR APPROXIMATION. Zaslavskii, G. M.; Filonenko, N. N. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki). Translated for Princeton Univ., N. J., from a Russian preprint. 47p. Dep. CFSTI.

The motion of particles in the field of a plane wave is investigated under the effect of perturbation. It is demonstrated that near the separatrix separating the "trapped" particles from the "drifting" particles a domain (an ergodic layer) is formed in which the particle motion is of a stochastic nature. For times which are not very large this leads to an increase in the average energy of the trapped particles. The described instability is used to investigate the motion of particles in the field of a wave packet with a large discrete set of harmonics. The conditions are obtained under which the motion may be described by an equation of the Fokker–Planck type (a quasi-linear equation) under arbitrary initial conditions without a priori assumptions regarding the presence of any random parameters in the system. The randomization time of the particle phases is calculated. (auth)

16832 STABILITY OF AXISYMMETRIC MHD EQUILIBRIA WITHOUT STAGNATION POINT. Lortz, D. (Institut fuer Plasmaphysik GmbH, Garching, Ger.). Phys. Lett., 28A: 509-10 (Jan. 13, 1969).

It is shown that there exist axisymmetric poloidal vacuum magnetic fields having special field lines with the property $dq/d\psi = 0$, $d^2q/d\psi^2 < 0$, $B \neq 0$, where B is the magnetic field strength, ψ the magnetic flux, and q the integral $\oint dl/B$ over a closed field line. (auth)

16833 STABILITY OF FLUTE DISTURBANCES IN A CYLINDER OF RAREFIED INHOMOGENEOUS PLASMA IN PRESENCE OF HIGH-FREQUENCY ELECTROMAGNETIC FIELD. Arsenin, V. V. Zh. Tekh. Fiz., 38: 453-6 (Mar. 1968). (In Russian).

To determine the influence of an inhomogeneous high-frequency field penetrating into a plasma on the low-frequency flute instability of a cylinder of rarefied plasma, the author calculated a model of a rarefied-plasma cylinder placed in a homogeneous magnetic field, with a radial "gravitational" force applied to the plasma particles; the influence of the gravity is assumed equivalent to the influence of a small curvature of the magnetic-field force lines. In solving the equations of motion of the plasma particles, it is shown that the flute instability of such a cylinder can be suppressed by sufficiently d[illegible] ρ modulation of the containing magnetic field, at a frequency exceeding the fundamental cyclotron frequency. It is shown that the stabilizing effect caused by the modulation of the high-frequency penetrating field is missing in the case of a dense plasma. (ATD)

16834 CONNECTION BETWEEN THERMODYNAMICAL AND DYNAMICAL STABILITY IN THE COLLISIONLESS PLASMA. Minardi, E. (FOM-Instituut voor Plasma-Fysica, Jutphaas, Netherlands). Physica, 38: 481-512 (June 5, 1968).

The connection is discussed between the extremum properties of the free energy and information functionals previously defined for characterizing collisionless (in general nonthermal) plasma equilibria and the stability of these equilibria described by means of the dynamical equations. For a given equilibrium many information functionals can be defined, each one being associated with a special class of excitation modes. These modes are selected by a special choice of the information variables, that is the variables depending linearly on one current component or on the charge density, through which the information density depends on space. A different choice of the coefficients of the linear dependence selects the excitation modes which are related to interchanges involving different kinds of energy, as for instance (in the low-β case) the part of the magnetic energy related either to the magnetization current or the guiding-center drift current, or also the gravitational energy, the azimuthal kinetic energy, and so on. The condition for a minimum of the proper information is necessary and sufficient for the instability of the associated modes in an infinite plasma. This is proved for a certain class of low-frequency non-MHD modes (near a marginal frequency $\omega = 0$) by showing that the condition for a minimum of the information is the same as the condition for the existence of associated zero-frequency modes which are marginally unstable as a result of a general stability analysis based on a Lagrangian formulation. In the case of low-β MHD interchanges or of the gravitational instability is shown that the minimum of the information, constructed by taking the drift current as information variable, implies a negative plasma energy variation during an interchange. So through the proper definition of the information variables and of the related interchange energy and information functional, a point of view is reached in which physically different instabilities can be seen in the frame of the same general formalism. It is hoped that, by means of a proper choice of the information variables, which can be suggested by physical considerations, other modes can be taken into account and that one can look for new possible unstable modes by examining the extremum properties of the related information functional. (auth)

16835 DYNAMIC CHARACTERISTICS OF A STRAIGHT TURBULENT DISCHARGE. Koidan, V. S.; Papyrin, A. N.; Ponomarenko, A. G.; Yablochnikov, B. A. JETP Lett. (USSR) (Engl. Transl.), 8: 241-4 (Oct. 20, 1968).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 8: 389-93 (Oct. 20, 1968).

An investigation was made of plasma heating by a straight-discharge current and its dynamics. A Penning discharge in air in a magnetic field of 1 to 3 kOe was used. The energy absorption and other plasma properties are determined by the ratio $\eta = j_\sim/j_0$. For $\eta \geq 1$, turbulence sets in with excitation of hf and lf oscillations. Power absorption and diamagnetic signal increase simultaneously with the active voltage. The density of the heated electrons is found to decrease towards the instant of maximum heating. It is concluded that the dynamics of turbulence development is influenced by the parameters of the initial plasma. (D.L.C.)

Wave Phenomena

Refer also to abstract 16622.

16836 (CEA-CONF-1004) ION CYCLOTRON INSTABILITY IN THE MAGNETIC WELLS OF DECA-II. Brossier, P.; Lecoustey, P.; Renaud, C.; Tachon, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1968]. 13p. (In French). (CN-24/H-7; CONF-680805-25). Dep.

From 3rd International Conference on Controlled and Plasma Physics, Novosibirsk, USSR.

The results of the study of the ion cyclotron oscillations observed in the quadrupolar magnetic well of DECA-II are reported. The experimental results are compared with the theoretical results of a model taking into consideration the density gradient, the distribution function of the hot ions, and the presence of a cold Maxwellian plasma. The experimental results showed that cold plasma can have a destabilizing role for hot plasmas having a loss cone distribution function. (tr-auth)

16837 (CEA-CONF-1007) STUDIES OF NONLINEAR PROCESSES. Cano, R.; Fidone, I.; Etievant, C.; Laval, G.; Olivain, J.; Pellat, R.; Perulli, M.; Zanfagna, B. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1968]. 25p. (In French). (CN-24/E-9; CONF-680805-26). Dep.

From 3rd International Conference on Controlled and Plasma Physics, Novosibirsk, USSR.

The theory of the nonlinear interaction of three-electron plasma waves received satisfactory experimental confirmation. The parametric amplification permitted the excitation of modes having a high-order spatial structure. It was established that an electron plasma wave can be nonlinearly unstable even for very low oscillation amplitudes. In spite of its length, the decay spectrum in its initial growth phase can be interpreted without recourse to the hypothesis of random phases. The nonlinear interaction produced in the plasma volume common with two beams of electromagnetic waves introduced perpendicular to the magnetic confinement field was studied for the nonlinear interaction of an ordinary wave and an extraordinary wave and for the nonlinear interaction of two ordinary waves. In the experimental study, two emission peaks were observed. The results showed the creation of an electromagnetic wave by resonating nonlinear interaction of two electromagnetic waves. The relations between the polarizations of the three waves were verified and the order of magnitude of the measured interaction coefficients is in agreement with the theoretical results. (J.S.R.)

16838 (N-68-31988) AN INVESTIGATION OF MICROWAVE INTERACTION WITH A PLASMA CONFINED IN A DIPOLAR MAGNETIC FIELD. Twardeck, T. G. (Pennsylvania State Univ., University Park. Dept. of Electrical Engineering). July 30, 1968. 113p. (NASA-CR-96142; SR-320). CFSTI.

An investigation of the properties of a plasma confined in the dipolar magnetic field of a uniformly magnetized sphere has been conducted. The main laboratory diagnostic tools were microwave interferometers operating at 3.0, 1.34, and 0.86 cm. Laboratory measurements included changes in received power and phase for various plasma densities, scattering angles, and frequencies, and changes in the received power for different pressures in the vacuum vessel, plasma densities, and frequencies. An idealized model of the scattering geometry is presented, and expressions for the scattering coefficients and scattered field quantities are formulated in terms of the plasma parameters. The digital computer techniques for evaluating the appropriate expressions are described and the influence of each physical parameter on the calculations is considered. The comparison of the simple theoretical model with experimental results indicates that in forward scattering angles the plasma is accurately described as a plasma shell characterized by a constant complex refractive index for the plasma densities, collision frequencies, and incident wave frequencies encountered in the laboratory investigation. (auth) (STAR)

16839 (N-68-34367) LABORATORY PLASMA WAVE EXPERIMENTS. Crawford, F. W. (Stanford Univ., Calif. Inst. for Plasma Research). Apr. 1968. 47p. (NASA-CR-96787; SU-IPR-236; CONF-680455-1). CFSTI.

From Conference on Plasma Waves in Space and in the Laboratory, Roros, Norway.

Small signal plasma wave propagation is normally analyzed in one of three limits. In the first, the plasma is assumed to be cold. In the next higher approximation, thermal motions are taken into account via transport equations. In the third, the Boltzmann equation is employed. Each approach has its postulated domain of validity which can ultimately be checked only by experiment. This paper outlines briefly the various basic wave modes predicted in the three approximations, and describes a few of the significant laboratory plasma wave experiments that have tested the applicability of each model. It is concluded that the major predictions of cold plasma theory, macroscopic theory, and the full microscopic theory have all been supported by experiments on near-Maxwellian plasmas. The success of the small signal theory provides the foundation on which extensions to nonlinear plasma behavior can be built with confidence. The next phase of experiment effort should be directed to detailed verification of such nonlinear theory. (auth) (STAR)

16840 (UUIP-615) INVARIANCE PROPERTIES OF WAVES IN A STREAMING MAGNETIZED PLASMA. Jarmen, A.; Wilhelmsson, H. (Uppsala Univ. (Sweden). Inst. of Physics). Nov. 1968. 4p. Dep.

Studied is an electron stream which had a velocity v with respect to the laboratory frame. Two coordinate systems are introduced. In one of them the static current density is zero, i.e., the system is at rest in the frame of the electron gas. The other system, which corresponds to the laboratory frame, then moves with a velocity v. Dispersion relations are given for wave propagation along a static magnetic field in the two systems. It is shown that the dispersion relations can be converted into each other by a transformation. This is in accordance also with a charge density transformation between the two systems. (Sweden)

16841 TRANSMISSION AND REFLECTION OF ELECTROMAGNETIC WAVES AT THE BOUNDARY OF A RELATIVISTIC COLLISIONLESS PLASMA. Oezizmir, Ercuement (Princeton Univ., N. J.). J. Math. Phys. (N. Y.), 9: 2018-28(Dec. 1968).

The exact solution of the transmission and reflection problem for transverse electromagnetic waves incident on a bounded plasma has been discussed to some extent by several authors. Shure considered the special cases of perpendicular incidence on nonrelativistic half-space and slab plasmas and made use of van Kampen–Case modes to construct the solution. For both half-space and slab plasmas, his results are generalized to (i) arbitrary temperatures (relativistic) and (ii) arbitrary angles of incidence. For simplicity, the special case is considered where the incident electric field is perpendicular to the plane of incidence and assume that particles are reflected specularly at the interface. A Laplace transformation was used in obtaining the solution. It is also shown that present solutions can be expressed as a superposition of van Kamper–Case modes appropriate to a relativistic plasma. (auth)

16842 WAVE PROPAGATION IN A PLASMA DRIFTING IN A MAGNETIC FIELD. Sharma, S. R. (Univ. of Rajasthan, Jaipur, India). Physica, 38: 625-32(June 5, 1968).

A relativistic theory is developed for the small-amplitude waves in a plasma drifting along an arbitrary direction in a magnetostatic field. Neglecting collisions and thermal effects, a general dispersion relation is derived which is discussed in detail for the cases of longitudinal and perpendicular magnetic fields and for the various directions of the drift velocity. The effect of the drift motion upon the various modes of wave propagation, resonances, and cutoff frequencies is discussed. (auth)

16843 SECOND HARMONIC GENERATION DUE TO INCIDENCE OF AN ELECTROMAGNETIC WAVE ON AN INHOMOGENEOUS PLASMA. Erokhin, N. S.; Zakharov, V. E.; Moiseev, S. S. (Novosibirsk State Univ., USSR). Zh. Eksp. Teor. Fiz., 56: 179-85(Jan. 1969). (In Russian).

It is shown that for waves with nonlinear dispersion, second harmonics can be generated in an inhomogeneous plasma. The intensity of second harmonic radiation from the region of plasma and electromagnetic wave resonance is determined, and it is shown that the coefficient for transformation of energy to the second harmonic may be of the order of unity for arbitrarily small incident-wave amplitudes. (auth)

16844 PLASMA IMPEDANCE AND ITS EQUIVALENT CIRCUIT. Wada, Ikuko (Tokyo Univ.). Trans. Inst. Electron. Commun. Eng. Jap., Part B, 51: 323-6(July 1968). (In Japanese).

An attempt was made to express the phenomenon of propagation of an electromagnetic wave in a plasma by the circuit treatment. As the result, it was found that various phenomena, obtained by the dispersion formula, can be expressed and understood by a simple equivalent circuit. The case where it was a plane wave with the propagation in direction parallel with and perpendicular to the external magnetic field was treated, but the method can be extended to the case where there is a reflection of electromagnetic wave in a direction perpendicular to it. (NSA of Japan)

16845 TRANSVERSE PLASMA-WAVE ECHOES. Fried, Burton D. (Univ. of California, Los Angeles. TRW Systems, Redondo Beach, Calif.); Olson, Craig. Phys. Rev., 180: 241-4 (Apr. 5, 1969).

The concept of plasma-wave echoes, introduced by Gould, Malmberg, O'Neil, and Wharton for the case of longitudinal, electrostatic waves, is here extended to the case where one of the excitations is a transverse electromagnetic wave propagating parallel to an external magnetic field, and the echo is of the same character. (If both excitations are transverse and $k_\perp = 0$, there is no transverse echo in lowest order.) A transverse electromagnetic signal of frequency ω_1 is excited at $z = 0$, and a longitudinal electrostatic signal of frequency ω_2 is excited at $z = L$. A transverse echo with frequency $\omega_1 \pm \omega_2$ then appears at $z_0 = \omega_2 L [\omega_2 \pm (\omega_1 + \Omega_c)]^{-1}$, where Ω_c is the signed cyclotron frequency of the species involved, and ω_1 is positive for right-hand polarization of the transverse excitation, negative for left-hand polarization. The expression for the echo location is correct for both $z_0 > L$ and $z_0 < 0$. The echo in the latter case arises from particles which have $v_z < 0$, and hence see the longitudinal excitation first, followed by the transverse excitation. In contrast to the purely longitudinal case, the echo frequency may either be the sum or difference of the excitation frequencies. Echoes due to a given species and given circular polarization for the transverse excitation may have either right- or left-handed polarization, depending on the

values of ω_1 and ω_2; echoes due to a given species (e.g., electrons and ions) occur at different locations and, in some cases, with different frequencies; and echoes arise for all values of ω_1 and ω_2, although the analysis is simple only if the waves associated with the excitations decay (due to Landau or cyclotron damping) in a distance less than L. A perturbation, Vlasov analysis, which takes into account all collective effects gives an expression for the echo shape in terms of a one-dimensional integral over v_z. (auth)

16846 SHOCK-WAVE STRUCTURE IN WEAKLY IONIZED PLASMA. Ikui, Takefumi; Muraoka, Katsunori (Kyushu Univ., Fukuoka). Nippon Kikai Gakkai Rombunshu, 34: 1103-9(June 1968). (In Japanese).

In this study, Oberai's method, based on Mott–Smith method, was extended to plasma, and the structures of unbalanced, weakly ionized plasma shock waves were investigated theoretically under various conditions. The results obtained were compared with Sinclair's theory and Sonin's experiment. Assuming experimental conditions in plasma wind tunnels, the problem was formalized. At first, the transport equations of $\phi(C)$ for Boltzmann's equation were formed, and the unknown factors in the distribution function $Fj(x,c)$ were determined with them. Mass, momentum, and energy, conserved before and after the collision, were adopted as $\phi(C)$, and the conservation equations were obtained. The following were discovered: (1) distribution of ionized particles was different from that of neutral particles; (2) thickness of the shock wave increased as the Schmidt number S_c^{-m}, employing the bipolar diffusion coefficient, decreased; (3) Sonin's experimental value at M = 2.2 was between Sinclair's theoretical value according to Navier–Stokes equation and the theoretical value of this investigation, but it is desirable to make experiments at the other M values. (NSA of Japan)

Shielding

Refer also to abstracts 16180, 17051, 17286, and 17292.

16847 (N-68-35535) TABLES OF ENERGY AND ANGULAR DISTRIBUTIONS OF THICK TARGET BREMSSTRAHLUNG IN METALS. Powell, Clemans A. Jr. (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). (NASA-TN-D-4755).

Calculations are made for the angular and energy distributions of bremsstrahlung produced in thick elemental metallic targets by normally incident monoenergetic fluxes of electrons with energies of 0.50, 0.75, 1.00, 2.00, and 3.00 MeV. Results are given for magnesium, aluminum, titanium, manganese, iron, nickel, copper, tungsten, gold, and lead. The target thickness was chosen to be the mean range of the electrons in the particular target material for the electron energy of interest. The theoretical analysis of these data is based on the approximation of a thick target by a series of thin slabs each of which is considered to be a thin target for bremsstrahlung production, and includes the following secondary processes: (1) the effect of multiple electron scatterings, (2) electron backscatter out of the target, (3) electron–electron bremsstrahlung, and (4) the absorption and buildup of photons in the target. Results are compared with experimental thick target bremsstrahlung data for aluminum and iron. Although the agreement is good, the predicted values tend to overestimate the experimental data for low photon energies and underestimate for higher photon energies. The discrepancy between the predicted and experimental values increases with increasing angular displacement from the incident electron direction and with increasing atomic number of the target material. (auth) (STAR)

16848 CALCULATING THE TRANSMISSION OF GAMMA RADIATION THROUGH AN INHOMOGENEOUS BARRIER. Kol'chuzhkin, A. M.; Uchaikin, V. V. At. Energ. (USSR), 25: 442-4 (1968). (In Russian).

The problem is formulated with the help of perturbation theory for a homogeneous barrier of thickness H. An expression is also given for the readings of a detector behind an inhomogeneous barrier of the same thickness. By assuming that the linear coefficient for Compton scattering is proportional to the electron density it is possible to obtain the results in analytical form with formulas not containing an integral operator that are more convenient for calculation. These formulas were used to calculate the buildup factors from a two-layer barrier of lead and water with a thickness of one mean free path length at a source energy of 1 MeV. A comparison of these results with Monte Carlo calculations showed good agreement for a thickness of the interposed layer up to one-half a mean free path length. (TTT)

16849 FAST-NEUTRON SPECTRUM AND DOSE-RATE MEASUREMENTS IN WATER AND ALUMINUM–WATER LAMINATIONS. Coulbourn, G. I.; Williamson, T. G. (Univ. of Virginia, Charlottesville). Nucl. Sci. Eng., 35: 376-83(Mar. 1969).

The fast-neutron spectrum and dose rate were measured at various distances from a point fission-neutron source in water and in two aluminum and water mixtures using seven threshold reaction detectors and p-i-n silicon diode dosimeters. The experimental results were compared with calculations made using the ANISN computer code. The threshold reactions used were the $^{115}In(n,n')$, $^{32}S(n,p)$, $^{64}Zn(n,p)$, $^{27}Al(n,p)$, $^{58}Fe(n,p)$, $^{24}Mg(n,p)$, and $^{27}Al(n,\alpha)$. Using experimentally determined counting efficiencies, absolute saturation activities of the threshold reaction products were determined. A method of neutron-spectrum unfolding was devised which represented the fast-neutron spectrum by a group of successive exponentials, calculated from the saturation activities. The reported spectra generally agreed well with the results predicted by the ANISN code. The fast-neutron dose rate was measured directly using p-i-n junction dosimeters and indirectly by applying flux-to-dose conversion factors to the measured fast-neutron flux. Good agreement was obtained between these measurements and calculations. (auth)

16850 DIFFERENTIAL DOSE ALBEDO FOR FAST NEUTRONS. Song, Y. T. (Univ. of Tennessee, Knoxville); Huddleston, C. M.; Chilton, A. B. Nucl. Sci. Eng., 35: 401-5(Mar. 1969).

A four-parameter semiempirical formula is derived for fast-neutron albedo based on current for multi-collision tissue-absorbed dose in rads. This formula is presented for differential dose albedo for a broad parallel beam of neutrons reflected from semi-infinite slabs of iron, concrete, aluminum, and earth. Neutron energies between 0.1 and 14 MeV are chosen. Earth is represented by Nevada Test Site soil: dry, 50%, and 100% moisture saturated. (M.H.R.)

16851 ENGINEERING COMPENDIUM ON RADIATION SHIELDING. VOLUME I. SHIELDING FUNDAMENTALS AND METHODS. Jaeger, R. G.; Blizard, E. P.; Chilton, A. B.; Grotenhuis, M.; Hoenig, A.; Jaeger, Th. A.; Eisenlohr, H. H. (eds.). New York, Springer-Verlag New York Inc., 1968. 548p. $60.00.

Basic concepts and calculation techniques are reviewed, definitive data required for shielding calculations are compiled, and many examples to illustrate the methods described are given. Practical problems such as shield heating and the effects of ducts and voids are discussed. Eight chapters are included and separate abstracts have been prepared for each. (M.H.R.)

For abstracts of individual chapters see: 16852–16859.

16852 DOSIMETRIC FUNDAMENTALS AND IRRADIATION LIMITS. pp 1-19 of Engineering Compendium on Radiation Shielding. Vol. I. Shielding Fundamentals and Methods. Jaeger, R. G. (ed.). New York, Springer-Verlag New York Inc., 1968.

The following subjects are covered: radiation quantities and units, irradiation limits, and the relationship between dose equivalent (absorbed dose) and fluence (flux density). (M.H.R.)

16853 RADIATION SOURCES. pp 20-100 of Engineering Compendium on Radiation Shielding. Vol. I. Shielding Fundamentals and Methods. Jaeger, R. G. (ed.). New York, Springer-Verlag New York Inc., 1968.

The radiation sources are covered under the following subjects: radioactive sources (both radionuclides and neutron sources), particle accelerators, and nuclear reactors. Extensive tabular data are included. (M.H.R.)

16854 RADIATION ATTENUATION METHODS. pp 101-66 of Engineering Compendium on Radiation Shielding. Vol. I. Shielding Fundamentals and Methods. Jaeger, R. G. (ed.). New York, Springer-Verlag New York Inc., 1968.

Most of the analytical radiation attenuation methods are included especially those which apply to either gamma rays or neutrons. Topics covered are: the application of the Monte Carlo method to shielding, point kernel methods, and the transport method. Included in the transport method are the following: neutron attenuation in hydrogenous media by the method of moments, matrix methods, direct integration methods (Niobe), and the discrete ordinates method (S_n). (M.H.R.)

16855 PHOTON ATTENUATION. pp 167-258 of Engineering Compendium on Radiation Shielding. Vol. I. Shielding Fundamentals and Methods. Jaeger, R. G. (ed.). New York, Springer-Verlag New York Inc., 1968.

The following subjects are covered: attenuation coefficients, energy absorption coefficients, and related quantities; photon atomic cross sections; broad beam attenuation; the backscattering of photons; and air scattering. (M.H.R.)

16856 NEUTRON ATTENUATION. pp 259-362 of Engineering Compendium on Radiation Shielding. Vol. I. Shielding Fundamentals and Methods. Jaeger, R. G. (ed.). New York, Springer-Verlag New York Inc., 1968.

The topics covered are: interaction processes, attenuation in hydrogenous media (methods and results), attenuation in nonhydrogenous media, and neutron scattering. (M.H.R.)

16857 EXTENDED RADIATION SOURCES (POINT KERNEL INTEGRATIONS). pp 363-416 of Engineering Compendium on Radiation Shielding. Vol. I. Shielding Fundamentals and Methods. Jaeger, R. G. (ed.). New York, Springer-Verlag New York Inc., 1968.

The following subjects are covered: point and extended sources, line sources, surface sources, volume sources, effect of scattered radiation, derivation of formulas, geometrical transformations, and mathematical formulas and graphs. (M.H.R.)

16858 RADIATION-INDUCED HEAT GENERATION. pp 417-86 of Engineering Compendium on Radiation Shielding. Vol. I. Shielding Fundamentals and Methods. Jaeger, R. G. (ed.). New York, Springer-Verlag New York Inc., 1968.

The following subjects are covered: survey of methods for calculating gamma-ray heating, heat generation by neutrons, analytical solutions for heat generation distributions in regular geometries, temperature distribution in radiation shields, and radiation-induced thermal stresses in long hollow cylinders. (M.H.R.)

16859 DUCTS AND VOIDS IN SHIELDS. pp 487-529 of Engineering Compendium on Radiation Shielding. Vol. I. Shielding Fundamentals and Methods. Jaeger, R. G. (ed.). New York, Springer-Verlag New York Inc., 1968.

The attenuation of gamma rays and neutrons in various duct geometries is covered. Neutron streaming is discussed briefly. (M.H.R.)

16860 NEUTRON DOSE RATE ATTENUATION BY IRON AND LEAD. Shure, K.; O'Brien, J. A.; Rothberg, D. M. (Bettis Atomic Power Lab., West Mifflin, Pa.). Nucl. Sci. Eng., 35: 371-5(Mar. 1969).

Effective removal sections for iron and lead that can be applied to fast-neutron dose rate calculations have been determined from calculated spatial–spectral neutron distributions as a function of succeeding polyethylene thickness. These cross sections increase with polyethylene thickness, and for large polyethylene thicknesses, they are in agreement with those derived from experiment. From the spatial–spectral neutron distributions, relative contributions of various neutron energy ranges to the neutron dose rate have been calculated as a function of succeeding polyethylene thickness. For polyethylene thicknesses >30 cm, fast (E > 302 keV), epithermal (302 keV > E > 0.625 eV), and thermal (E < 0.625 eV) neutrons contribute 83, 6, and 11%, respectively, to the neutron dose rate. (auth)

16861 SHIELDING OF NEUTRONS FROM 80-MeV ALPHA-PARTICLE BOMBARDMENT OF TANTALUM. Wadman III, William W. (Univ. of California, Irvine). Nucl. Sci. Eng., 35: 220-6(Feb. 1969).

The angular distribution, yield, spectra, and attenuation of fast neutrons from the alpha-particle bombardment of a thick elemental tantalum target have been measured. Data obtained by using threshold energy detectors and thermal-neutron detectors were reduced to neutron spectra with the computer program FLUXPOS. Thermal-neutron activation foils were placed in the shielding at 6-in. intervals to determine the neutron attenuation profiles at 0, 75, and 90° from the target. Data show that the neutron spectral slope becomes steeper and the relaxation length (1/e attenuation thickness) decreases with increasing angle. (auth)

16862 COMPOSITION AND METHOD FOR SHIELDING COMPONENTS FROM NEUTRON IRRADIATION. Ronzio, A. R. (to Morco Oil Corp.). Canadian Patent 797,750. Oct. 29, 1968).

Anhydrous naphthenic and 2-ethyl hexanoic acid salts of Cd, Gd, and Sm are soluble in molten paraffin or beeswax. This solution is poured over parts or components requiring protection shielding from neutron irradiation. The encapsulated part also becomes a nonconductor of electric current after this treatment. The method of producing the protective compound in anhydrous form is described. The solubility in ordinary paraffin is about 10%. (F.S.A.)

16863 THE EFFECTS OF MULTIPLE COULOMB SCATTERING AND RANGE STRAGGLING IN SHIELDING AGAINST SOLAR-FLARE PROTONS. Alsmiller, R. G. Jr. (Oak Ridge National Lab., Tenn.); Barish, J.; Scott, W. W. Nucl. Sci. Eng., 35: 405-6(Mar. 1969).

In studies of the shielding required on manned spacecraft to protect against solar-flare protons and the trapped protons in the Van Allen belt, it is usually assumed that the incident protons travel in a straight line through the shield and undergo a continuous energy loss. The validity of this approximation is tested by comparing calculations including multiple Coulomb scattering and range straggling. The proton transport calculations that include multiple Coulomb scattering and range straggling were carried out with the code PROTOS. This code employs Monte Carlo methods. The proton transport calculations that neglect multiple Coulomb scattering and range straggling were carried out using the standard solution to the approximate proton transport equation. At the back face of the slab, the Monte Carlo results are slightly lower than the results of the approximate calculation, presumably because the backscattered protons are not present to contribute to the Monte Carlo dose. In general, the approximation that incident protons travel in a straight line through the shield and undergo a continuous slowing down seems to be quite adequate for space-vehicle shielding studies. (M.H.R.)

16864 ENERGY BUILDUP FACTORS OF GAMMA RADIATION IN SPHERICAL AND SLAB SHIELDS. Partolin, O. F.; Larichev, A. V.; Chistov, E. D. At. Energ. (USSR), 26: 78-9(Jan. 1969). (In Russian).

Energy buildup factors of γ radiation from ^{203}Hg, ^{198}Au, ^{137}Cs, and ^{60}Co point sources in spherical and slab shields of lead, iron, and aluminum 300 × 300 × 5, 400 × 400 × 3, and 500 × 500 × 3 mm, respectively, were estimated. The hemisphere thickness varied from 5 to 75 mm. Measurements were carried out at 1-m distances, using a small halogen counter with energy range from 0.06 to 3 MeV. Curves were constructed for the magnitude of the buildup factor δ for shields as a function of the thickness of the shielding and γ-ray energy at 1-m detector–source distances and as a function of the atomic number of the shielding material Z at $\mu x = 2$ thickness and ^{203}Hg and ^{137}Cs γ radiation. Data obtained showed that the shape of shields influences the energy buildup factors of γ radiation. (R.V.J.)

16865 THE ATTENUATION OF SPACE PROTONS BY THIN CYLINDRICAL SHELL AND SLAB DISK SHIELDS. Madey, Richard; Huetter, G. Thomas (Clarkson Coll. of Tech., Potsdam, N. Y.). Nucl. Sci. Eng., 35: 406-8(Mar. 1969).

Analytical expressions are presented for the proton flux density on the axis of cylindrical and slab shields bombarded by an isotropic inverse power-law spectrum of protons. A trigonometric expression is obtained for the proton flux density at an axial point behind a thin plane slab disk shield in terms of the spectral exponent γ of the incident isotropic inverse power-law spectrum of protons and the parameter α in a power-law representation of the range–energy relation for the material of the shield. The restriction to thin shields means that the greatest path length through the shield material is smaller than a mean-free-path for nuclear interaction. This restriction limits the contribution to the flux density from secondary radiations. (M.H.R.)

Solid-State Physics

Refer also to abstracts 15848, 15863, 15892, 15901, 16139, 16205, and 16214.

16866 (CEA-CONF-1028) POST-IRRADIATION RECOVERY OF TWO HEXAGONAL, FERROMAGNETIC METALS: COBALT AND GADOLINIUM. Cope, R.; Sulpice, G.; Minier, C.; Bilger, H.; Moser, P. [1968]. 15p. (CONF-680322-1). Dep.

From Conference on the Physics of Metals, Berlin, Germany.

Co and Gd were bombarded by 3-MeV electrons at 20°K or neutrons at 28°K and the resistivity recovery curve determined after the irradiations. A rather complex defect annealing spectrum was found for both. The kinetics of the defect annealing was studied using different doses. A magnetic after-effect was found for irradiated Co and is associated with the 50–60°K resistivity stage, which obeys first order kinetics. The defects responsible for the recovery behavior are discussed. (D.L.C.)

16867 (CEA-CONF-1029) STUDY OF STAGE I IN IRRADIATED NICKEL. de Keating-Hart, G.; Cope, R.; Minier, C.; Moser, P. [1968]. 17p. (CONF-680322-3). Dep.

From Conference on the Physics of Metals, Berlin, Germany.

The fine structure in the resistivity recovery curve of electron-irradiated single-crystal Ni and the effects of the beam direction (⟨100⟩, ⟨110⟩, and ⟨111⟩) on the recovery I peaks were studied. Internal friction measurements were also done after irradiations with neutrons at 28°K and electrons at 20°K, with and without magnetic field. The internal friction results are correlated with the resistivity and magnetic after-effect. An attempt is made to identify the different stages, and a close-pair model is proposed. (D.L.C.)

16868 (CEA-CONF-1030) POINT DEFECTS IN IRON. Bilger, H.; Hivert, V.; Verdone, J.; Leveque, J. L.; Soulie, J. C. [1968]. 18p. (CONF-680322-2). Dep.

From Conference on the Physics of Metals, Berlin, Germany.

Studies were made of the annealing of defects in iron, using

measurements of electric resistivity, stored energy, rigidity modulus, internal friction, and magnetic after-effect. The defects were introduced into the iron by irradiation with electrons or neutrons, and the effects of impurities were studied. The types of defects responsible for each annealing stage are discussed. (D.L.C.)

16869 (CEA-CONF-1191) MAGNETIC STRUCTURES AND PROPERTIES OF $UFeO_4$. Bacmann, M.; Bertaut, E. F.; Blaise, A.; Chevalier, R.; Roult, G. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires. Centre National de la Recherche Scientifique, Grenoble (France)). [1968]. 10p. (CONF-681121-1). Dep.

From 14th Conference on Magnetism and Magnetic Materials, New York.

Moessbauer effect studies, neutron diffraction, and magnetic measurements show that at T_N = 55°K, the Fe moments of the orthorhombic compound $UFeO_4$ (a = 4.888 Å, b = 11.937 Å, c = 5.110 Å; space group $Pbcn\text{-}D_{2h}^{14}$) order antiferromagnetically along Oy. Below T_c = 42°K, a non-collinear structure develops with a ferromagnetic component along Oz and an antiferromagnetic component along Ox. At 4.2°K, the moment values, determined by neutron diffraction are 4 μ_B for the ferromagnetic and 2 μ_B for the antiferromagnetic component per iron atom. There is also a measurable antiferromagnetic component of about 0.4 μ_B on the U atom. $UFeO_4$ is one of the rare examples of an oxide which is a ferromagnetic insulator. (auth)

16870 (CEA-R-3606) STUDY OF SOME LATTICE DEFECTS WITH HELP OF CHANNELED α PARTICLES. Quere, Yves (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1968. 75p. (In French). Dep.

Thesis. Submitted to Univ. of Paris, Orsay, France.

A method is described in which a metallic foil is irradiated by isotropic α particles. The thickness of the foil is such that only channeled particles can traverse it. The emerging flux, a function of the local concentration of defects, falls on a collector where an image of the foil is formed. The influence of grain or twin boundaries, of stacking faults, of dislocations, is observed. A quantitative study of dislocation is presented. The effect of a dislocation is represented by the presence of a coaxial dechanneling cylinder of diameter: $\overline{\lambda} = (b\ d\ a\ E/\alpha Z_1 Z_2 e^2)^{1/2}$, where b is the Burgers vector; d the interatomic distance along the channel; a the screening radius of the interaction between the particles (Z_2) and the metal (Z_1); E the energy of the particles; α a numerical parameter. There is a reasonable agreement with experimental results. Channeling patterns, observed in all metals, are described. They are more numerous if the metal has been treated some time in gaseous atmospheres. They correspond to zones, on the metal, situated on the side of entrance of particles. It is proposed that, in these zones, gaseous atoms strengthen the channels and enhance channeling. (auth)

16871 (STI/PUB-205) THEORY OF CONDENSED MATTER. Lectures Presented at an International Course held in Trieste, 3 October–16 December 1967. (International Centre for Theoretical Physics, Trieste (Italy). International Atomic Energy Agency, Vienna (Austria)). Sept. 1968. 1021p. IAEA: $20.00; Australian Schillings 517,-; £8.6.8; F Fr 98,-; DM 80,-.

Separate abstracts were prepared for ten papers dealing with Fourier transformations and correlation functions, neutron spectroscopy, neutron scattering studies of critical phenomena and magnetic materials, neutron spectrometry, neutron scattering by molecules, neutron scattering studies of atomic motions, positron annihilation in liquids and solids, electron energy bands of Be and superconductivity. The remaining papers (19) deal with selected topics in the general theory, dynamical lattice properties, electronic properties, and liquids and molecules. (D.C.W.)

For abstracts of individual papers see: 16142, 16662, 16756, 16891–16894, 16896, 17058, and 17059.

16872 STAGE-III ANNEALING IN Al AFTER DEUTERON IRRADIATION AT DIFFERENT TEMPERATURES. Herschbach, K. (McDonnell Douglas Corp., Santa Monica, Calif.); Jackson, J. J. Phys. Rev., 177: 1049-53(Jan. 15, 1969).

Stage-III annealing in annealed as well as in cold-worked aluminum was found to be essentially the same whether deuteron irradiations were performed at a temperature below 10°K followed by warming to 90°K (treatment I), or by irradiating at 90°K to an equal resistivity increase (treatment II). Consequently, di-interstitial formation can be ruled out as a significant contribution to stage-III annealing, since there are never enough free interstitials to combine with each other during treatment II. It is postulated that annealing can best be accounted for by a modified two-interstitial model with part of the stage-I interstitials converted into stage-III interstitials instead of being annihilated with vacancies. The completeness of annealing in stage III suggests that in aluminum, as opposed to other fcc metals, stage III and stage IV completely overlap and cannot be resolved. Therefore, the last part of "stage III" must represent vacancy migration. This interpretation is supported by the difference of annealing curves. It is also shown that deviation from Matthiessen's rule cannot explain the increased damage production in cold-worked specimens. (auth)

16873 LATTICE VIBRATIONS IN MOLYBDENUM. Walker, C. B. (Army Materials and Mechanics Research Center, Watertown, Mass.); Egelstaff, P. A. Phys. Rev., 177: 1111-22 (Jan. 15, 1969).

A neutron inelastic scattering study has been made of the normal modes of vibration of molybdenum in a $(1\bar{1}0)$ plane at room temperature using a cold-neutron chopper time-of-flight technique. The measured frequency–wave-vector results are in general agreement with the symmetry-axis data of Woods and Chen but show further anomalous behavior in several regions in this plane. The "normal" phonons (those not in anomalous regions) are fitted acceptably by Born–von Karman general force models that include at least six neighbors with a relatively large value for the sixth-neighbor force constant. The anomalous regions appear to be examples of Kohn anomalies, and two of these are interpreted on this basis to give information on dimensions of the near-planar sections of the Lomer model of the Fermi surface. (auth)

16874 HYPERFINE INTERACTIONS OF Eu NUCLEI IN $SmFe_7$, Sm_2Co_{17} AND Sm_2Ni_{17}. Armon, H.; Bauminger, E. R.; Hess, J.; Mustachi, A.; Ofer, S. (Hebrew Univ., Jerusalem). Phys. Lett., 28A: 528-9(Jan. 13, 1969).

The hyperfine splittings of the 103.2-keV γ line of ^{153}Eu in $SmFe_7$, Sm_2Co_{17}, and Sm_2Ni_{17} have been measured using the Moessbauer effect technique. The magnetic and quadrupole moments of the 103.2-keV level were determined. Conclusions concerning the various contributions to H_{eff} were drawn. (auth)

16875 POINT DEFECTS IN GADOLINIUM AFTER ELECTRON AND NEUTRON IRRADIATION. Cope, R.; Minier, C.; Bilger, H.; Moser, P. (CEN, Grenoble, France). Phys. Lett., 28A: 510-11(Jan. 13, 1969).

Point defects produced in gadolinium by electron and neutron irradiation at low temperatures were studied by resistivity and magnetic after-effect measurements. Essentially, the recovery occurs in stage I below 115°K and in several stages at about room temperature. (auth)

16876 DEFORMATION OF LATTICES OF TWO RARE-EARTH PHOSPHIDES. Hulliger, F.; Levy, F. (Laboratoire de Physique, Zurich). Phys. Lett., 28A: 471-2(Jan. 13, 1969). (In French).

The rocksalt structure of TbP undergoes a trigonal, that of DyP a tetragonal, distortion of the Néel point. (auth)

16877 MAGNETIC FIELD AT ^{119}Sn IN GADOLINIUM. Gotthardt, V.; Moeller, H. S.; Moessbauer, R. L. (Technische Hochschule, Munich). Phys. Lett., 28A: 480-1(Jan. 13, 1969).

The magnetic field at ^{119}Sn dissolved (0.2 at. %) in Gd has been measured. The sign of the magnetic field was determined to be negative, in contrast to other reported measurements on less dilute samples. (auth)

16878 KNIGHT SHIFTS OF ^{51}V AND ^{55}Mn IN VANADIUM–MANGANESE ALLOYS. Von Meerwall, E.; Schreiber, D. S. (Northwestern Univ., Evanston, Ill.). Phys. Lett., 28A: 495-6 (Jan. 13, 1969).

Both ^{51}V and ^{55}Mn NMR in the vanadium bcc solubility region in V–Mn alloys were observed. Resonance intensities, Knight shifts, and widths in samples with up to 50% Mn are reported. (auth)

16879 X-RAY IRRADIATION AND THE BARKHAUSEN EFFECT IN TRIGLYCINE SULFATE AND ROCHELLE SALT CRYSTALS. Komlyakova, N. S. (Kalinin State Pedagogical Inst., USSR). Uch. Zap. Gos. Pedagog. Inst., 60: 75-9(1967). (In Russian).

An experimental investigation was made of the Barkhausen effect in triglycine sulfate and Rochelle salt crystals as affected by x-ray irradiation from the URS-55 device (0.1 kr/min) with varying dosages. The effect of irradiation was deduced from the distribution of domain wall (Barkhausen) jumps in various crystal specimens. It was found that irradiation, though not changing the general character of the distribution curve, affects the threshold field and the number of jumps as functions of the dose. The threshold field values were found to rise monotonously as the dose increases. The number of jumps as a function of dose first rises sharply, passes a maximum and then drops, tending to flatten out at higher dose values. The maxima,

and to a lesser degree the number of jumps, differ in different samples. (ATD)

16880 NUCLEAR MAGNETIC RESONANCE FOR FLOW MEASUREMENT. Nyblom, Ake (Kungliga Tekniska Hogskolan, Stockholm). Tek. Tidskr., 99: No. 3, 63-4(1969). (In Swedish).

A brief description is given on the application of NMR on flow measurement. (Swed)

16881 TEMPERATURE DEPENDENCE OF LATTICE DISORDER CREATED IN Si BY 40 keV Sb IONS. Picraux, S. T. (California Inst. of Tech., Pasadena); Westmoreland, J. E.; Mayer, J. W.; Hart, R. R.; Marsh, O. J. Appl. Phys. Lett., 14: 7-9 (Jan. 1, 1969).

The temperature dependence of lattice disorder created in Si by 40-keV Sb ions was studied by energy analysis of the yield of backscattered 1-MeV He ions incident along ⟨111⟩ and ⟨110⟩ axes. Doses of $\sim 1 \times 10^{13}$ Sb ions/cm^2 were used so that the disorder level was below that representing an amorphous layer. The disorder per incident ion decreases strongly with implant temperature above 50°C. This is approximately 100°C lower than the region of corresponding decrease in the anneal of a low-dose room-temperature implantation. For implantation temperatures less than 50°C, the disorder per ion was only mildly temperature-dependent. (auth)

16882 AN IRRADIATION EFFECT IN THERMALLY GROWN SiO_2. Wells, Oliver C. (IBM Watson Research Center, Yorktown Heights, N. Y.). Appl. Phys. Lett., 14: 5-6(Jan. 1, 1969).

Thermally grown silicon dioxide layers were irradiated with kilovolt electrons, and the equilibrium surface potential was measured by passing the secondary electrons through an energy analyzer. The incident electrons at 5-keV energy penetrate for 3300 Å into a 5700-Å oxide film. The observed equilibrium surface potential is initially less than 1 V which indicates efficient induced conductivity; but after 10 C/cm^2 it is −30 V (which indicates that the conductivity has diminished); and finally at 20 C/cm^2 it is less than 1 V again. Annealing reverses the process. A model is proposed. (auth)

16883 DISPERSION RELATIONS FOR HEXAGONAL CLOSE-PACKED CRYSTAL LATTICES. Metzbower, E. A. (Johns Hopkins Univ., Baltimore). Phys. Rev., 177: 1139-43(Jan. 15, 1969).

The dispersion relations for waves propagating in the [0001] and [01$\bar{1}$0] directions were calculated, using a Born–von Kármán model of the hexagonal close-packed crystal lattice. The interactions between nearest neighbors in the plane were considered to be central forces, while the interactions between nearest and next-nearest neighbors out of the plane were considered to be noncentral forces, i.e., the interactions involved both central and angular forces. The atomic force constants were evaluated (1) from the elastic constants by the method of long waves, (2) from a least-squares analysis of the eigenvalues of the secular equation for elastic waves propagating in certain symmetric crystallographic directions at critical points in the Brillouin zone, i.e., from a least-squares analysis of the dispersion relations, and (3) from a least-squares analysis of the elastic constants and the dispersion relations. The correlation between theoretical and experimental dispersion relations from the noncentral-force model is good for magnesium and zinc and is limited for beryllium. If the atomic force constants have been calculated by a least-squares analysis of certain points in the dispersion relations with or without the elastic constants, these atomic force constants greatly enhance the agreement between theory and experiment. As a result of this work, it seems that better agreement between theory and experiment is obtained if angular forces are included in a model of the hcp crystal lattice rather than simply extending the sphere of interaction to more and more neighbors. (auth)

16884 ANNEALING OF DEFECTS PRODUCED IN n-TYPE Ge BY ELECTRON IRRADIATION AT 30°K. Hiraki, A.; Cleland, J. W.; Crawford, J. H. Jr. (Oak Ridge National Lab., Tenn.). Phys. Rev., 177: 1203-7(Jan. 15, 1969).

Attention is focused upon a primary radiation defect in n-type germanium created by 1.5-MeV electron bombardment at 30°K. This defect anneals in a stage centered near 150°K but is not present when specimens are exposed at 10°K to 0.7-MeV electrons or at 77°K to either 1.0-MeV electrons or ^{60}Co γ rays. The 150°K stage can be shifted to lower temperatures under the influence of white light and, presumably, ionizing radiation. The characteristics of this defect are similar to those found by Vook and Stein for the so-called irradiation-temperature-independent defects produced by electron bombardment of n-type silicon in the temperature range 77 to 150°K. Therefore, the same model is adopted as they, namely, that the defect responsible for the 150°K annealing stage is a nonreorientable divacancy anchored in a fixed orientation by an interstitial nearby ($I-V_2$ defects). From this experiment, it can be concluded that the principal defects introduced by irradiation below 65°K with electrons less than 1 MeV are close pairs which anneal in a stage centered near 65°K, whereas irradiation with electrons of energy greater than 1 MeV introduces $I-V_2$ defects also. (auth)

16885 PARAMAGNETIC RESONANCE OF ROOM-TEMPERATURE-STABLE V-TYPE CENTERS IN γ-IRRADIATED ALKALI HALIDE–BORON OXIDE GLASSES. Griscom, D. L.; Taylor, P. C.; Bray, P. J. (Brown Univ., Providence). J. Chem. Phys., 50: 977-83(Jan. 15, 1969).

Numerous glasses were prepared from mixtures of alkali halides and boron oxide and subjected to ^{60}Co γ rays at room temperature; these were examined by ESR techniques at 9.1 and 35 GHz. The induced spectra can be divided into two categories: (1) a resonance due to boron–oxygen centers previously studied in alkali borate glasses, and (2) certain new resonances which are shown to be due to V-type centers (halogen$_2^-$ molecule-ions). The Cl_2^- species is stable at room temperature; its spin-Hamiltonian parameters determined by means of a computer simulation of the spectrum are: $g_{\parallel} = 2.0042$, $g_{\perp} \approx 2.035$, $^{35-35}A_{\parallel} = 100$ G, $^{35-35}A_{\perp} \approx 8$ G. Inclusion of small amounts of KCl or LiCl in borate glasses can result in nearly total suppression of the usual boron–oxygen-center resonance, i.e., the dissolved chloride ions prove to be the more efficient hole traps. The Br_2^- centers can also be formed, but less efficiently. The F_2^- centers are not produced in borate glasses which is consistent with other data which suggest that fluorine forms covalent bonds with boron in these materials. (auth)

16886 ELECTRON SPIN RESONANCE STUDIES OF MAGNETIC CENTRES IN FAUJASITE-TYPE CRYSTAL STRUCTURES PRODUCED BY IONISING RADIATION. Stamires, D. N. (Princeton Univ., N. J.). pp 328-33 of Molecular Sieves. London, Society of Chemical Industry, 1968.

From Conference on Molecular Sieves, London, Eng. See CONF-670455-3.

It is shown that it is possible to create three types of magnetic centers in faujasite-type crystals by ionizing radiation. Specifically, three types of electron spin resonances are observed: one line assigned to an electron vacancy located on the oxygen atom adjacent to two [SiO_4] units, another ESR signal (with hyperfine structure of 13 lines) assigned to one electron trapped in a 4 Na^+ site with these Na^+ ions in the lattice located at cation sites of the II type, and the third type of resonance being a single line assigned to an uncoupled electron located far apart from ^{23}Na and ^{27}Al sites. This probably is present in the large cavities of the unit cell. The three types of ESR signals are very sensitive to cation density in the crystals, degree of degassing, extent of heating, and presence of foreign molecules in the crystal lattice. A suitable combination of these factors must be chosen before it is possible to observe the particular type of resonance. In general, high cation density in the crystals prevents the two types of resonance of the electrons to be observed. This is due to the strong electrical field present in the lattice, which delocalizes the electrons, and hence ESR is not observed. Small amounts of water present in the lattice, which interact with certain types of cations, allow the electrons to be trapped in particular types of cationic sites, giving well resolved hyperfine structure. The pink colour observed is due to the electrons in the crystal lattice and can be bleached by either heating or adsorption of gases. The electron vacancy is rather stable and not affected appreciably by the above mentioned factors. The electrons can however be trapped and become localized, firstly by cation sites (Na^+), secondly by adsorbed molecules such as O_2 to form O_2^- centers, and thirdly by strong electron acceptor sites such as [AlO_4]. An analogy is drawn between the zeolite centers and the F-centers in alkaline halides, and the observed Δg shifts appear to be very close to theoretically predicted values in both cases. It was possible to account for the adsorption properties of the zeolite crystals with magnetic centers by considering electric field-induced dipole interactions with nonpolar molecules. It was also possible to explain theoretically the selectivity of these crystals for D_2 over H_2 adsorption. From the zeolite data, it was possible to obtain a further substantiation of the theory for gas-solid interactions for nonpolar molecules adsorbed on polar surfaces. Finally, the catalytic properties of irradiated zeolites are accounted for and attributed to the presence of electron vacancies as being responsible for the pronounced catalytic activity for chemical reactions such as the H_2D_2 exchange. The importance of the crystallinity of the zeolites is emphasized, and is considered to be the main factor which makes possible the formation of the magnetic centers. (auth)

16887 ENERGY DISTRIBUTION OF ATOMS SPUTTERED FROM POLYCRYSTALLINE METALS. Stuart, R. V.; Wehner,

G. K.; Anderson, G. S. (Litton Systems, Inc., Minneapolis). J. Appl. Phys., 40: 803-12(Feb. 1969).

The energy distributions of atoms sputtered from various polycrystalline metals by Kr^+ ions of energies up to 1200 eV were determined using a spectroscopic time-of-flight method. Measurements of the Doppler shift of light emitted in the direction of travel by sputtered Mo and Ag atoms have verified the time-of-flight measurements. Average ejection velocities range from 4×10^5 (Ag) to 11×10^5 (Be) cm/sec; average ejection energies increase with the atomic number of the target atoms, while average velocities decrease. Higher sputtering yield materials tend to exhibit lower ejection energies. The crystal structure seems to play no important role in ejection energies. No evidence for focusing collisions could be derived from ejection energy data. (auth)

16888 ELECTRICAL RESISTIVITY OF ALPHA URANIUM AT LOW TEMPERATURES. Brodsky, M. B.; Griffin, N. J.; Odie, M. D. (Argonne National Lab., Ill.). J. Appl. Phys., 40: 895-7(Feb. 1969).

The electric resistivity of alpha U was measured along specific crystallographic directions between 4.5 and 300°K. The resistivity-tensor components for [100], [010], and [001] are compared with previous values; the anisotropy remains large to the lowest temperatures. Slope changes at 42 and 36°K are easily seen in the single crystals, but barely discernible in the polycrystalline samples. A thermal hysteresis is found between 12 and 40°K. The results are explained by the assumptions that cooling to 42°K initiates the $\alpha \rightarrow \alpha_0$ transition, which is completed by 36°K; cooling below 36°K causes lattice strains; reheating above 10°K produces hysteresis due to these strains; and net annealing of the strain begins on heating above 20°K. The temperature dependence of the resistivity is discussed for both the single-crystal and polycrystalline samples, and an attempt is made to fit the data to the Bloch-Gruneisen function. (D.L.C.)

16889 EQUILIBRIUM CONFIGURATIONS OF DISLOCATIONS UNDER STRESS: COMPARISON OF EXPERIMENTAL OBSERVATIONS WITH THEORY. Pare, V. K.; Crump III, J. C. (Oak Ridge National Lab., Tenn.). J. Appl. Phys., 40: 790-3(Feb. 1969).

Single crystals of copper were compressed and irradiated with fast neutrons while under load to pin dislocations in their stress-applied positions. Thin electron-microscope samples were prepared with surfaces parallel to the primary slip plane, and micrographs were taken of dislocations lying in this plane. The equilibrium shapes of these dislocations were compared with those predicted by the theory of DeWit and Koehler. A computer and digitally controlled plotter were used to generate curves representing the theoretical dislocation shapes, and these curves were plotted on transparent film for superposition onto micrographs of dislocations. The stresses thus measured on dislocations observed in samples compressed to 40, 100, and 500 g/mm^2 resolved shear stress were found to agree closely with the applied stress, even through a majority of the dislocations studied were in the vicinity of other dislocations, which might be expected to modify the stress acting on the dislocations studied. (auth)

16890 STUDY ON THE FORMATION OF SMOKY COLOR CENTERS IN γ-IRRADIATED α-QUARTZ BY MEANS OF THERMOLUMINESCENCE AND DIELECTRIC BEHAVIOR. Lee, Hee Yong (Atomic Energy Research Inst., Seoul). J. Korean Phys. Soc., 1: 9-16(Mar. 1968).

The thermoluminescent properties of two types of γ-irradiated Korean natural quartz were examined. One kind is extremely sensitive to radiation (type 1), while the other type is extremely radiation-resistant (type 2). It was found that the non-T.L. (no thermoluminescence) smoky color center, identifiable as an ^{Al}A defect, was induced in the γ-irradiated type-2 quartz. The properties of, $^{Al}A_+$, $_XP_-$ and ^{Al}A defect centers in both kinds of γ-irradiated quartz are discussed by measuring their thermoluminescence and dielectric behavior. Tentative interpretations of the thermoluminescent effect of these defect centers are given in terms of the current theories of thermoluminescent phosphors. The $^{Al}_{X}P_+$ defect center proposed by Milne is also discussed. (auth)

16891 KOHN-ROSTOKER METHOD FOR ELECTRON ENERGY BANDS OF BERYLLIUM. Singh, R. P. (Indian Inst. of Tech., Bombay). pp 941-C8 of Theory of Condensed Matter. Vienna, International Atomic Energy Agency, 1968.
STI/PUB-205.

The paper is primarily a general theoretical development under the following main topics: (1) derivation of the method for simple Bravais lattices; (2) evaluation of structure constants, and (3) Kohn-Rostoker method for complex lattices. The case of beryllium is briefly discussed, citing calculations on the energy band structure by three individual authors, and proposing to make use of some of the quantities of the development (above) in order to perform Kohn-Rostoker type calculations. (L.M.T.)

16892 NEUTRONS AND CRITICAL PHENOMENA. Jacrot, B. (Centre d'Etudes Nucleaires, Saclay, France). pp 483-99 of Theory of Condensed Matter. Vienna, International Atomic Energy Agency, 1968.
See STI/PUB-205.

The application of neutron scattering to the investigation of critical phenomena is discussed. Phase transitions and the theory of neutron scattering are reviewed, and some of the results that have been obtained are summarized. (D.C.W.)

16893 INVESTIGATIONS OF MAGNETIC MATERIALS USING NEUTRON SCATTERING. Marshall, W.; Low, G. G. (Atomic Energy Research Establishment, Harwell, Eng.). pp 501-38 of Theory of Condensed Matter. Vienna, International Atomic Energy Agency, 1968.
See STI/PUB-205.

Neutron scattering is claimed to be the most powerful single technique for investigating magnetic solids. Basic equations are given with examples of their application. The determination of magnetic moment distribution is discussed for ferromagnetic metals, transition metal complexes, and disordered alloys. Formulas are given for paramagnetic and critical scattering by ferromagnets; the problems of inelasticity of the scattering and of temperatures near T_c are considered. (D.L.C.)

16894 SELECTED TOPICS IN NEUTRON SPECTROMETRY. Caglioti, G. (Comitato Nazionale per l'Energia Nucleare, Ispra, Italy). pp 539-59 of Theory of Condensed Matter. Vienna, International Atomic Energy Agency, 1968.
See STI/PUB-205.

The relation between the information obtainable by diffraction of neutrons and other radiations in liquid metals and the transport properties of electrons in the metal itself is discussed. The application of the method of elastic diffraction of neutrons to the physics of condensed matter is also examined. (B.G.D.)

16895 CALCULATION OF RESONANCE DISTRIBUTION. Shimony, U. (Israel Inst. of Tech., Haifa). Nucl. Instrum. Methods, 68: 173-5(Feb. 1, 1969).

The understanding of the physical processes involved in resonance spectra such as Mössbauer spectra is greatly enhanced if a way is found to calculate the distribution of the oscillators. Given the observed spectrum, a mathematical way of doing so is suggested. This can be adapted for numerical processing of experimental data. (auth)

16896 FOURIER TRANSFORMS AND CORRELATION FUNCTIONS. Cochran, W. (Univ. of Edinburgh). pp 307-24 of Theory of Condensed Matter. Vienna, International Atomic Energy Agency, 1968.
See STI/PUB-205.

Fourier transforms, which appear in problems of radiation scattering by condensed matter, and their properties are discussed. The applications of Fourier transforms in structural crystallography, lattice dynamics, and inelastic neutron scattering are considered, with equations given in detail. (D.L.C.)

16897 THEORY OF SURFACE SCATTERING AND DETECTION OF SURFACE PHONONS. Cabrera, N.; Celli, V.; Manson, R. (Univ. of Virginia, Charlottesville). Phys. Rev. Lett., 22: 346-8(Feb. 24, 1969).

A formal theory for the investigation of crystal surfaces by the scattering of particles is developed. Expressions satisfying the condition of unitarity are presented for diffraction as well as one-photon inelastic scattering, including the effects of surface bound states. The possibility of detection of surface phonons by scattering of low-energy He atoms from a cleaved surface is investigated. (auth)

16898 CHARGE-STATE POPULATIONS OF 5- TO 36-MeV CHANNELED OXYGEN AND CARBON IONS. Martin, F. W. (Univ. of Aarhus, Denmark). Phys. Rev. Lett., 22: 329-32 (Feb. 24, 1969).

Equilibrium and nonequilibrium charge-state distributions have been obtained for high-energy ions emerging from crystals. In a major channeling direction in silicon, the slower ions and those incident in low charge states emerge nearly at equilibrium, with a mean charge close to that in a random direction. High-energy channeled oxygen 8^+ ions emerge far from equilibrium, indicating a capture cross section of less than 2×10^{-19} cm^2. (auth)

16899 INVESTIGATION OF THE MOESSBAUER EFFECT OF ULTRAFINE TUNGSTEN PARTICLES. Roth, S.; Hoerl, E. M. (Institut fuer Metallurgie, Seibersdorf, Austria). Acta Phys. Austr., 27: 264-70(1968). (In German).

The Debye-Waller factor of ultrafine W crystals was investi-

gated using the Moessbauer effect. The measurements were made on the 46.5-keV level of ^{183}W. The dependence of the Debye–Waller factor for microcrystals on the upper and lower boundary temperatures was shown. The values obtained for Q_{DM}, $Q_{(E)}$, and $Q_{(K)}$ are tabulated and compared with previous results. (J.S.R.)

16900 NUCLEAR MAGNETIC RESONANCE. Jonas, J.; Gutowsky, H. S. (Univ. of Illinois, Urbana). Annu. Rev. Phys. Chem., 19: 447-76(1968).

Publications on NMR emphasizing phenomena, new experimental and theoretical methods, and new areas of application are reviewed. Exchange processes, nuclear relaxation, chemical shifts, indirect spin–spin coupling, solid-state studies, and biological applications are considered. Ion cyclotron resonance is also discussed. (377 references). (M.C.G.)

16901 MOESSBAUER EFFECT ON IMPURITY NUCLEI IN METALLIC MATRICES. Kuz'min, R. N.; Opalenko, A. A.; Shpinel', V. S. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.), 8: 279-81(Nov. 5, 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 8: 455-7(Nov. 5, 1968).

Sources of the resonant ^{125}Te 35.6-keV γ quanta were made of tin enriched to 90% with ^{124}Sn, irradiated by a neutron flux, and introduced by fusing, in amounts 0.5 to 1 wt %, into gold, silver, copper, palladium, tin, indium, lead, and magnesium of very high purity. The samples were then rolled to a thickness 20 to 25 μ and annealed for several hours. The Moessbauer spectra were plotted by an electrodynamic setup with linear velocity variation, the source and absorber being at liquid-nitrogen temperature, with the absorber in motion. The quanta were registered with a scintillation counter with a NaI(Tl) crystal 0.1 mm thick in accordance with the emission peak. The absorber thickness was 19 mg/cm^2. The line widths, the magnitude of the effect, and the isomer shifts were measured and tabulated. (M.H.R.)

16902 DYSPROSIUM–GADOLINIUM EXCHANGE INTERACTIONS IN GADOLINIUM METAL. Nowik, Israel (Hebrew Univ., Jerusalem). J. Appl. Phys., 40: 414-15(Jan. 1969).

Recent experimental results on the temperature dependence of the hyperfine field acting on dysprosium impurity nuclei in gadolinium metal are used to check the validity of the molecular field model for such systems, and to reduce the Dy–Gd exchange coupling parameter. It is concluded that the molecular field model is able to explain successfully the experimental observations. The exchange field acting on dysprosium ions embedded in gadolinium metal, $\beta H_e(0°K)/k = 110 \pm 5°K$, is approximately equal to the field acting on the gadolinium ions ($\beta H_e(0°K)/k = 98°K$). (auth)

Theoretical Physics

Refer also to abstracts 16941 and 17298.

16903 (NP–17744) PROGRESS REPORT NO. 14, SESSION 1967–1968. (Oxford Univ. (England). Mathematical Inst.). 115p. (PD–5814). Dep.

Brief summaries of progress are given for various research projects in: general quantum theory, foundations, applications of functional analysis, group theory, and bounds to eigenvalues; atoms and small molecules; large molecules (chiefly π-electron problems); time-dependent phenomena and chemical reactions; solids; and metallurgy. (W.D.M.)

16904 UNIFORMLY VALID ASYMPTOTIC APPROXIMATION FOR THE QUANTIZED ANHARMONIC OSCILLATOR AT HIGH ENERGIES. Handelsman, Richard A.; Lew, John S. (Brown Univ., Providence). J. Chem. Phys., 50: 1182-94(Feb. 1, 1969).

A uniformly valid asymptotic expansion is obtained for the solution of the one-dimensional time-independent Schrödinger equation which describes an anharmonic oscillator. As is well known this leads to a two-turning-point problem in asymptotic analysis. The expansion itself is determined for large values of an appropriately constructed parameter λ which can be specialized to $4J(E)/2\pi\hbar$. It is shown to be valid for high energies which, in turn, implies that the turning points are well separated. The technique employed is an extension of that used previously by the authors for low energies, i.e., for nearby turning points. The energy levels are obtained implicitly to all orders in λ^{-1} by a relation which generalizes the traditional Bohr–Wilson–Sommerfeld quantum condition. For analytic potentials the leading terms in the asymptotic expansion of this relation are obtained in terms of contour integrals and are found to agree with the corresponding higher-order JWKB results of Dunham. Finally, the normalization of the eigensolutions is discussed and a procedure for obtaining the asymptotic expansion of the normalization constant is indicated. (auth)

16905 RELATIVISTIC DYNAMICS OF A POINT CHARGE IN A MAGNETIC-MONOPOLE FIELD. Mitchell, Thomas P. (Univ. of California, Santa Barbara); Burns, J. A. J. Math. Phys. (N. Y.), 9: 2016-17(Dec. 1968).

The constants of the charge's motion are derived and discussed. The physical meaning of these constants and their use in discussing the overall motion of the charge are presented. (auth)

16906 DILUTE SYSTEM OF FERMIONS IN A BOSON BACKGROUND. Stenholm, S. T. (Oxford Univ.). Physica, 38: 608-24(June 5, 1968).

The properties of a dilute fermion system in a background capable of supporting boson excitations are discussed. A decoupling-procedure for the Green functions is introduced which reduced the problem to a calculation of the collective excitations of the system. The background is found to renormalize the fermions and modify their interaction. Expressions for the fermion effective mass are given and connections with recent work on ^3He in ^4He are discussed. (auth)

16907 LINEAR RESPONSE, BETHE–SALPETER EQUATION, AND TRANSPORT COEFFICIENTS. Picman, Lovro (Inst. for Nuclear Research, Ljubljana, Yugoslavia). Symp. Theor. Phys. Math., 6: 27-37(1968).

The Bethe–Salpeter equation for thermodynamic Green's functions has been studied on several occasions, usually with some approximative kernels. In this paper, some general features of this equation are pointed out, and its applicability in constructing a linearized kinetic equation with generalized kernel as well as in calculating transport coefficients is stressed. The author limits himself to a self-bounded infinite system, uniform in space (gas, liquid); more specifically, a normal system of fermions is considered. The central quantity of interest is the linear response functions L(p,k) of the particle number density. This function describes small deviations from equilibrium when a weak external field is applied to the system. (L.M.T.)

16908 SYMPOSIA ON THEORETICAL PHYSICS AND MATHEMATICS. VOLUME 6. Lectures Presented at the 1966 Fourth Anniversary Symposium of the Institute of Mathematical Sciences, Madras, India. Ramakrishnan, Ailadi (ed.). New York, Plenum Press, 1968. 306p.

Separate abstracts were prepared for 16 of the 20 lectures; 4 of the lectures were not in scope for Nuclear Science Abstracts. (L.M.T.)

For abstracts of individual papers see: 16619, 16686, 16907, 16932, 16941–16943, 16960, 16964, 16972, 16982, 16986, 17005, 17006, 17071, and 17132.

16909 UNIFIED FORMULATION OF THE KINETIC EQUATIONS. Balescu, R. (Univ. Libre, Brussels). Physica, 38: 98-118(Mar. 10, 1968).

It is shown that a formulation of nonequilibrium statistical mechanics is possible in such a way as to treat symmetrically homogeneous and inhomogeneous systems, vacuum, and correlations. These special cases needed distinct treatment in hitherto develped formalisms. The new formulation makes extensive use of so-called "projection operators." These are defined abstractly by using a minimum of assumptions. Very compact equations are obtained by using this formalism; these equations contain all previously known results as special cases. However, it is shown that the abstract "projection operators" also allow for realizations more general than the ones used hitherto. These realizations are important in the study of inhomogeneous systems of coupled oscillators (or fields). It is also shown that the conventional name "projection operators" is a quite improper one. The symmetry of the formulation is essential for the study of certain problems in which the usual decompositions have no intrinsic meaning (such as the study of relativistic invariance). (auth)

16910 LIMIT CYCLE SOLUTIONS OF A SCALAR MODEL NONLINEAR FIELD THEORY AND THE HARTREE QUANTUM LEVELS. Leiter, Darryl (Boston Coll., Chestnut Hill, Mass.). Can. J. Phys., 47: 117-22(Jan. 1, 1969).

A scalar model nonlinear field theory is constructed from an action principle so that the inherent "limit cycle solutions" of the theory correspond to the eigensolutions of the conventional Hartree equation for helium. The properties of the "limit cycle transition" solutions are discussed and offer an alternative method, for solving the nonlinear Hartree eigenvalue equation, which has the distinct advantage of not requiring the spherical averaging approximation inherent in the conventional "self-consistent field" calculations. The elements which control the speed of convergence of a limit cycle transition solution into a limit cycle solution are analyzed; a method of speeding up the process in order to make it competitive in terms of computer

time, with the conventional self-consistent field calculation is discussed. (auth)

16911 DERIVATION OF THE GENERALIZED MASTER EQUATION FOR COMPOSITE PARTICLES. Schieve, W. C.; Mitchell, J. D. (Naval Radiological Defense Lab., San Francisco). Physica, 38: 559-78(June 5, 1968).

Generalized master equations for composite particles are derived. The methods of Girardeau are used to construct the appropriate representation of the density matrix for particles having internal degrees of freedom. The proper exchange symmetry between particles is described as an initial condition on the Von Neumann–Liouville equation. The generalized master equations are then obtained for diagonal and off-diagonal matrix elements by a generalization of the projection technique of Zwanzig. The form of the equations is shown to be exactly the same as that obtained by Prigogine for structureless particles. The $\lambda^2 t$ approximation is discussed and it is shown that in this limit the particles will approach an equilibrium state in which exchange between the composite particles may be ignored. (auth)

16912 KINETIC EQUATIONS AND LORENTZ TRANSFORMATION. Balescu, R. (Univ. Libre, Brussels). Physica, 38: 119-32(Mar. 10, 1968).

It is known that, within the canonical formulation of statistical mechanics initiated by Dirac and developed by the author and Kotera, the Liouville equation is invariant under Lorentz transformations. As a direct consequence, it is shown that the general master equation, which is conceptually equivalent to the Liouville equation, is also Lorentz invariant. The asymptotic kinetic equation, valid for large systems and long times can obviously not be exactly invariant. It is shown, however, that a property of asymptotic Lorentz invariance can be proved, precisely within the domain of validity of the kinetic equation. This asymptotic invariance is valid provided a condition on the initial condition is satisfied: the class of acceptable initial conditions must be closed under Lorentz transformations. (auth)

16913 INTRODUCTION TO NONEQUILIBRIUM STATISTICAL PHYSICS. Prigogine, I. pp 216-350 of Topics in Nonlinear Physics. Zabusky, Norman J. (ed.). New York, Springer-Verlag New York, Inc., 1968.

General discussions are given for the following areas: (1) thermodynamics of irreversible processes, (2) statistical mechanics-general method, (3) Boltzmann situations, (4) generalized Boltzmann situations, (5) non-Boltzmann situations, (6) irreversibility, and (7) entropy. (M.O.W.)

16914 TOPICS IN NONLINEAR PHYSICS. Proceedings of the Physics Session International School of Nonlinear Mathematics and Physics, Munich, 1966. Zabusky, Norman J. (ed.). New York, Springer-Verlag New York, Inc., 1968. 754p.

A conference on nonlinear physics is presented. Separate abstracts were prepared for three papers. Other papers not within the scope of NSA covered nonlinear field theories in mechanics, nonlinear optics, and homogeneous turbulence. (J.F.P.)

For abstracts of individual papers see: 16821, 16913, and 16998.

16915 POISSON DISTRIBUTION OF HIGH ENERGY BREMSSTRAHLUNG RADIATION. Gorshkov, V. G. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz., 56: 597-604(Feb. 1969). (In Russian).

It is demonstrated that in the double-logarithmic approximation the cross section for emission of n photons with small perpendicular momenta can be expressed by the Poisson formula. (auth)

16916 INFLUENCE OF A MAGNETIC FIELD ON THE BROWNIAN MOTION OF PARTICLES WITH MAGNETIC MOMENT. Hess, Siegfried (Univ., Erlangen, Ger.). Z. Naturforsch., 23a: 1911-13(Dec. 1968).

The influence of a magnetic field on the diffusion of Brownian particles with a magnetic moment parallel to their internal angular momentum is discussed. Starting point is a generalized Fokker–Planck equation. Application of the moment method leads to a set of transport–relaxation equations. From them the diffusion tensor depending on the external field is inferred. (auth)

16917 COMMENTS ON "THE ACCELERATION MAGNETIC FIELD OF A STEADY-CURRENT LOOP." Gagnon, Ralph J. (Carnegie–Mellon Univ., Pittsburgh). Proc. IEEE (Inst. Elec. Electron. Eng.), 57: 242-3(Feb. 1969).

Contrary to recently reported results, centripetal acceleration in a current loop is shown not to result in an azimuthal, inverse-square magnetic field. (auth)

16918 RADIATION OF CHARGED PARTICLES IN PERIODIC LATTICES. Bolotovskii, B. M.; Voskresenskii, G. V. (Lebedev Inst. of Physics, Moscow. Radiotechnical Inst., Moscow). Usp. Fiz. Nauk, 94: 377-416(Mar. 1968). (In Russian).

Theoretical and experimental data on radiation of charged particles in motion near a diffraction lattice are briefly reviewed. 44 references. (R.V.J.)

16919 INTERPRETATION OF $\Gamma^i_{(jk)}$ IN A HUYGENS MODEL. Muraskin, Murray (Univ. of Nebraska, Lincoln. Univ. of North Dakota, Grand Forks). J. Math. Phys. (N. Y.), 9: 2056-60(Dec. 1968).

A classical field theory is described based on Huygens' principle which is characterized by an additional degree of freedom which, to our knowledge, has not been discussed previously. This additional degree of freedom asserts that the forward propagation cone is different from the backward cone. The purpose is to find a function which describes this degree of freedom, and next, to understand this effect in reference to other theories. It is found that this additional degree of freedom can be described by means of $\Gamma^i_{[jk]}$. The object $\Gamma^i_{(jk)}$ is then related to the torsion of a preferred-frame geometric theory. The additional degree of freedom is of interest since it enables one to introduce $\Gamma^i_{[jk]}$ in a framework involving characteristic equations, described by g_{ij}, and bicharacteristics described by $\Gamma^i_{(jk)}$, such that the role of $\Gamma^i_{[jk]}$ can be understood. Also, the theory furnishes a generalized framework for gravitational theory. Paths with noncontinuous slopes appear also in Feynman's path-integral approach. Thus, this type of discontinuity has physical interest here also, although this point is not pursued. (auth)

16920 RELATIVISTIC QUANTUM THEORY OF FERMI AND BOSE PERFECT GASES. Lanlignel, A. (Ecole Mohammadia d'Ingenieurs, Rabat, Morocco). Acta Phys. Pol., 34: 895-912 (Nov. 1968). (In French).

The relativistic quantum theory of Fermi or Bose perfect gases is explained in detail beginning with the known energy distribution, and expressions are given for the volume, the particular momenta, kinetic temperatures (or mean energies), the pressure, the Carnot temperature, the entropy, heat content, and thermodynamic potentials as a function of two independent variables, using three special functions. But the formulation is somewhat clumsy, and it is advantageous to know the conditions which permit the complete relativistic expressions to be dispensed with for a certain close approximation. One is thus led to use three series of formulas which correspond to three different states of the gas. This leads to the notion of a nonrelativistic area of approximation, a relativistic area and an ultrarelativistic area. These areas are delimited numerically in the case where one seeks precision of a thousandth. (tr-auth)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 16939.

Electromagnetic

Refer also to abstract 16933.

16921 (ORNL-TM-2308) A SEARCH FOR A NEUTRON ELECTRIC DIPOLE MOMENT BY THE METHOD OF NEUTRON BEAM MAGNETIC RESONANCE. Baird, James Kern (Oak Ridge National Lab., Tenn.). Feb. 1969. Contract W-7405-eng-26. 255p. Dep. CFSTI.

Thesis. Submitted to Harvard Univ., Cambridge, Mass.

The technique and results of a neutron beam magnetic resonance experiment sensitive to a neutron EDM are reported herein. The design of the experiment is approached from the point of view of optimizing the critical parameters so as to achieve the ultimate sensitivity lying within the limitations of the available experimental methods. Among the techniques exploited is the use of a beam of ultra-slow neutrons having a characteristic velocity corresponding to a source temperature of 1°K. A careful analysis of the data for systematic errors is presented and a realistic statistical error computed. If μ_e is the EDM, and e is the charge of the proton, the experiment shows that $\mu_e = (1.85 \pm 1.14) \times 10^{-23}$ e × cm. This result rules out the possibility of parity and time reversal nonconservation in the electromagnetic interactions and suggests, but does not confirm, the existence of parity and time reversal nonconservation in the weak and/or strong interactions. (auth)

16922 (SLAC-PUB-532(Exp.)) PHOTOPRODUCTION OF RHO MESONS AT 9 GeV. Bulos, F. (Stanford Linear Accelerator Center, Calif.); Kauffman, L. (California Univ., Berkeley. Lawrence Radiation Lab.); Beniston, M.; (and others) (IBM Scientific Center, Palo Alto, Calif.). [1967]. 29p. (CONF-680809-45). Dep. CFSTI.

From 14th International Conference on High Energy Physics, Vienna, Austria.

Preliminary results are presented for a study of vector meson production by 9-GeV monochromatic photons. The experiment was performed on six complex nuclei targets (beryllium, carbon, aluminum, copper, silver, and lead) and with liquid hydrogen and deuterium targets. Only the 9-GeV data are presented. It is concluded that the photoproduction of rho mesons at 9 GeV remains a dominant reaction in the γ to 2π channel. This meson continues to have asymmetric shape, and preliminary fits to the data indicate that it is consistent with a mass of about 765 and a width of about 120 MeV. An estimate of the coupling constant between the photon and the rho meson is also given. (J.F.P.)

16923 MULTIPLE COULOMB SCATTERING OF 19.8-GeV/c PROTONS IN NUCLEAR EMULSION. Kim, C. O. (Korea Univ., Seoul). J. Korean Phys. Soc., 1: 41-7(Mar. 1968).

Flat beam tracks of 19.8-GeV/c protons (2.3 m total), recorded on stripped K-5 emulsions (5″ × 8″ × 0.6 mm), were measured with a basic cell size of 100 μ on the stage of a digitized Koristka MS-2 microscope with automatic motorized driving, where y-readings were read onto the IBM cards. The dependence of scattering constant K on a cell size t was studied both by the standard sagitta method and by a new angular method, especially for t > 10 mm, and was found to be consistent with the values predicted by Fichtel et al. Apparently the cause of anomalous reduction of K for t ≥ 8 mm, reported by several authors, seems to be due to the "flat-chamber effect," which may be experimentally imposed in selecting tracks for measuremeats. (auth)

16924 PHOTOPRODUCTION OF RHO MESONS FROM COMPLEX NUCLEI AT 9 BeV. Bulos, F. (Stanford Univ., Calif.); Busza, W.; Giese, R.; (and others). Phys. Rev. Lett., 22: 490-4(Mar. 10, 1969).

The absolute differential cross section for photoproduction of neutral rho mesons from complex nuclei was measured at a photon energy of 8.8 BeV. Using a two-parameter optical model, a value was deduced for the total rho-nucleon cross section of 30^{+4}_{-7} mb. Application of the vector-dominance model results in a value for the rho-photon coupling of $\gamma_\rho^2/4\pi = 1.1 \pm 0.2$. (auth)

16925 HIGH-ENERGY PHOTOPRODUCTION OF ρ^0 MESONS FROM HYDROGEN AND DEUTERIUM. McClellan, G. (Cornell Univ., Ithaca, N. Y.); Mistry, N.; Mostek, P.; Ogren, H.; Silverman, A.; Swartz, J.; Talman, R.; Gottfried; Lebedev, A. I. Phys. Rev. Lett., 22: 374-7(Feb. 24, 1969).

The photoproduction of ρ^0 mesons from hydrogen and deuterium was measured as a function of the photon energy k_γ, and the square of the momentum transfer, t. The assumption that the ρ is produced by a purely diffractive mechanism is mildly contradicted by the data. (auth)

Weak

16926 (BNL-13279) SEARCH FOR DECAY $K_S^0 \to \pi^+\pi^-\pi^0$. Berley, D.; Yamin, P. (Brookhaven National Lab., Upton, N. Y.); Kofler, R.; Mann, A.; Meisner, G.; Yamamoto S. (Massachusetts Univ., Amherst); Tanenbaum, W.; Thompson, J.; Willis, W. (Yale Univ., New Haven, Conn.). [1968]. 6p. (CONF-690107-1). Dep. CFSTI.

From International Conference on Weak Interactions, Geneva, Switzerland.

The results of a search for the decay $K_S^0 \to \pi^+ + \pi^- + \pi^0$ are presented. A sample of K^0 was produced in the charge-exchange reaction $K^- + p \to n + \bar{K}^0$ with 400 MeV/c incident K^- in the 30-inch BNL–Columbia hydrogen bubble chamber. The results are consistent with previous results and do not demand any CP violation. (J.F.P.)

16927 (UCRL–18653) SEARCH FOR THE DIRECT DECAY MODES $K^+ \to \mu^+ + \nu + \gamma$ AND $K^+ \to \pi^+ + \gamma + \gamma$. Chen, Min (California Univ., Berkeley. Lawrence Radiation Lab.). Jan. 1969. Contract W-7405-eng-48. 99p. Dep. CFSTI.

A search was made for the direct decays $K^+ \to \mu^+ + \nu + \gamma$ and $K^+ \to \pi^+ + \gamma + \gamma$ using spark chambers. For the former decay 27 events were found with muon kinetic energy between 137 and 142 MeV. Each of these events was associated with a converted gamma ray shower. The upper limit for the branching ratio of this decay is found to be 1.1 (10^{-6}) at 90% confidence level. For the second decay, out of 6780 events with good gamma ray showers 29 ± 5.5 events were found that fitted the decay hypothesis within the energy and spacial resolution. The branching ratio for the $K^+ \to \pi^+ + \gamma + \gamma$ decay has an upper limit of 1.1 (10^{-4}) at a confidence level of 90%.

16928 DETERMINATION OF THE $\Sigma^+ \to \Lambda\, e^+\nu$ DECAY PARAMETERS. Eisele, F.; Engelmann, R.; Filthuth, H.; (and others). (Univ., Heidelberg). Z. Phys., 221: 1-8(1969).

From about 6×10^6 stopping K^--meson reactions in the Saclay 80-cm hydrogen bubble chamber 70 $\Sigma^- \to \Lambda e^-\bar{\nu}$ and 11 $\Sigma^+ \to \Lambda e^+\nu$ decays were identified. The ratio of the vector to axial vector coupling constant was determined, $f_1/g_1 = -0.22 \pm 0.28$, consistent with the prediction $f_1 = 0$ of the CVC-theory. The branching ratios for the two decay modes are, $\Gamma(\Sigma^- \to \Lambda e^-\bar{\nu})/(\Sigma^- \to \text{all modes}) = (0.69 \pm 0.12) \cdot 10^{-4}$, $\Gamma(\Sigma^+ \to \Lambda e^+\nu)/\Gamma(\Sigma^+ \to \text{all modes}) = (0.29 \pm 0.10) \cdot 10^{-4}$. The ratio, $\Gamma(\Sigma^+ \to \Lambda e^+\nu)/\Gamma(\Sigma^- \to \Lambda e^-\nu) = 0.69 \pm 0.18$, agrees with the phase space ratio, 0.61, therefore a theory that includes no second class currents is consistent with the data. (auth)

16929 POSSIBLE SEARCH FOR $K^+ \to \pi^+ + \nu + \bar{\nu}$ DECAYS. Galaktionov, Yu. V.; Shabalin, E. P. JETP Lett. (USSR) (Engl. Transl.), 8: 369-71(Nov. 20, 1968).

Translated from Zh. Eksp. Teoret. Fiz., Pis'ma Redaktsiyu, 8: 600-2(Nov. 20, 1968).

Attention is called to the possibility of searching for the decays $K^+ \to \pi^+ + \nu + \bar{\nu}$ up to a probability value $w(K^+ \to \pi^+ + \nu + \bar{\nu})/w(K^+ \to \text{all}) = 10^{-5}$. A setup for this experiment is described. (J.F.P.)

Strong (Baryon-Induced)

16930 HIGH ENERGY INTERACTIONS. Shen, Ming-liang. Rochester, N. Y., Univ. of Rochester, 1968. 237p.

Thesis.

Methods of determining the primary energy of cosmic ray jets are reviewed and the corrections which have been developed to improve the basic assumptions are discussed to clarify their limit of applicability. Under the circumstances that only the emission angles of charged secondaries are utilized for measurement, it is shown that one can determine only λ_j, the Lorentz factor of the symmetric system in which the total momentum of the charged secondaries is zero, instead of γ_c, the Lorentz factor of the system in which the primary interaction is produced. To avoid the disadvantages inherent in the usual methods, a new method, called the "γ_j-method," has been developed for determining the primary energy of cosmic ray jets based mainly on the trans-

verse momentum of the charged secondary shower particles. (TSS) (Disser. Abstr.)

16931 SEARCHES FOR THE GRAVITATIONAL MOMENT OF THE PROTON. Velyukhov, G. E. (Ioffe Physico-Technical Inst., USSR). JETP Lett. (USSR)(Engl. Transl.), 8: 229-32 (Oct. 5, 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 8: 372-5(Oct. 5, 1968).

The experimental setup consisted of two pairs of Helmholtz coils which compensated the field to within 10^{-3} Oe. It can be shown that a proton with a gravitational moment in a field will precess with a certain frequency forming a right-hand and a left-hand system of coordinates. A consistent analysis shows that the nuclear magnetic resonance varies with the direction of the field. The observed effect of the relative shift of NMR frequencies of protons at vertical and horizontal orientations of this field is shown. (J.F.P.)

Strong (Meson-Induced)

Refer also to abstract 16930.

16932 A SURVEY OF π-N SCATTERING, AND OF THE $T = \frac{1}{2}$ AMPLITUDES. Moyer, Burton J. (Indian Inst. of Tech., Kanpur). Symp. Theor. Phys. Math., 6: 271-86(1968).

A partial survey of experiments providing insight into the $\pi + N$ interaction for the energy region 400 to 1500 MeV incident pion energy is presented. Particular attention is devoted to the $T = \frac{1}{2}$ amplitudes for the 400 to 700 MeV interval and to a discussion of reaction channels possibly accounting for their behavior. A brief comparison of previous phase shift calculations is given. (J.F.P.)

16933 STUDY OF THE MECHANISM OF FORMATION OF ELECTRON–POSITRON PAIRS IN π^-p INTERACTIONS WITH A 10 GeV/c MOMENTUM. Takibaev, Zh. S. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat. Nauk, 1-5(July-Aug. 1968). (In Russian).

An attempt is made to explain the mechanism of generation of electron-positron pairs in the centers of stars. Two conclusions are reached: (1) Electron-positron pairs observed in the centers of stars during 10 GeV π^-p-interactions are formed as the result of the decay of π^0-mesons according to the Dalitz scheme $\pi^0 \rightarrow \gamma e^- e^+$ (Proc. Phys. Soc., 64: 379A, 1951, 667). (2) The number of π-mesons in an interaction, determined according to the conversion γ-quanta, is equal to 2.2 ± 0.2; the average energy of the π^0-meson is 1.28 ± 0.16 BeV; and the energy imparted to the π^0-mesons from 4-beam interactions is $26 \pm 4\%$. (auth)

16934 INVESTIGATION OF THE MECHANISM OF THE REACTION $^{12}C(\pi^-,\pi^-p)^{11}B$ AT 1.04 GeV/c MOMENTUM. Agan'yants, A. O.; Bayukov, Yu. D.; Vorob'ev, L. S.; (and others) (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.), 8: 226-9(Oct. 5, 1969).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 8: 366-71(Oct. 5, 1968).

The mechanism of the reaction $^{12}C(\pi^-,\pi^-p)^{11}B$ is studied by performing the measurements necessary for the identification of the pole mechanism and the experimental results are compared with the predictions of the theory of direct nuclear reactions. Data were obtained on the dependence of the differential cross section on the invariant mass of the π^-p system, the spectrum of the π^- mesons scattered at a fixed angle, the distribution with respect to the angle between the meson (π^-) and proton paths, and the angular distribution of the recoil nuclei. They agree qualitatively with the theoretical calculations. (J.F.P.)

16935 PRODUCTION OF Σ HYPERONS IN K^-p INTERACTIONS. Barnes, V. E. (Brookhaven National Lab., Upton, N. Y.), Flaminio, E.; Montanet, L.; Samios, N. P.; Skillicorn, I. O.; Goldberg, M.; Jaeger, K. Phys. Rev. Lett., 22: 479-82(Mar. 10, 1969).

The observation of the production in high-energy K^-p interactions of four Σ hyperon states, the $\Sigma(1385)$, $\Sigma(1660)$, $\Sigma(1940)$, and $\Sigma(2280)$, is reported. The properties of the $\Sigma(1385)$ and $\Sigma(1660)$ are in good agreement with previous observations. The $\Sigma(1940)$, in contrast to previous evidence, has a strong $\Sigma\pi$ decay mode which agrees with its assignment to the SU(3) $\frac{5}{2}^+$ octet. Finally, the existence of the $\Sigma(2280)$ has been confirmed and some of its decay modes exhibited. (auth)

16936 STUDY OF THE ENHANCEMENT IN THE Λp INVARIANT MASS NEAR THE ΣN THRESHOLD IN $K^-d \rightarrow \Lambda p\pi^-$ INTERACTIONS AROUND 1.0 GeV/c. Alexander, Gideon (Univ. of California, Berkeley); Hall, Bronwyn H.; Jew, Nathan; Kalmus, George; Kernan, Anne. Phys. Rev. Lett., 22: 483-6(Mar. 10, 1969).

Data are presented for the reaction $K^-d \rightarrow A\pi^-p$ at 910, 1007, and 1106 MeV/c in which the proton momentum is greater than 250 MeV/c. The Λp invariant-mass plot shows an enhancement at about 2130 MeV, similar to that found by Cline, Laumann, and Mapp. No enhancement is seen at about 1440 MeV in the $\Lambda\pi$ invariant mass. A simple two-step process describes our data as well as those of Cline, Laumann, and Mapp without the use of resonances. (auth)

16937 EVIDENCE FOR AN ISOSPIN-$\frac{1}{2}$ Kπ ENHANCEMENT AT A MASS OF 1160 MeV PRODUCED IN K^-n INTERACTIONS AT 3.9 GeV/c. Crennell, David J.; Karshon, Uri; Lai, Kwan Wu; O'Neall, John S.; Scarr, J. Michael (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Lett., 22: 487-9(Mar. 10, 1969).

The observation is reported of an isospin-$\frac{1}{2}$ Kπ enhancement at a mass of 1160 ± 10 MeV with a width of 90 ± 30 MeV from the reaction $K^-n \rightarrow K^0_S\pi^-n$ at 3.9 GeV/c. (auth)

Particle Interactions and Properties (Theoretical)

16938 LECTURES IN THEORETICAL HIGH ENERGY PHYSICS. Aly, H. H. (ed.). New York, John Wiley and Sons, Inc., 1968. 448p. $17.50.

Separate abstracts are prepared for the thirteen lectures presented. (L.B.S.)

For abstracts of individual lectures see: 16944, 16959, 16961, 16962, 16974–16976, 16990–16992, and 17007–17009.

General

Refer also to abstracts 16908, 16959, 16985, and 16987.

16939 (AED-C-23-32) HIGH ENERGY PHYSICS INDEX. Volume 6, No. 11 (6920-7613). (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). 1968. 258p. Dep.

A monthly report of the periodicals, books, conference proceedings, reports, and preprints received at DESY on experimental and theoretical high-energy physics is presented. An author index, preprint and report number index, and a subject index are included. (W.H.K.)

16940 (NYO-3399-166) LECTURES ON CURRENT ALGEBRAS. Lectures by A. P. Balachandran. Meggs, William J. (Syracuse Univ., N. Y. Dept. of Physics). Jan. 1969. Contract AT(30-1)-3399. 158p. (SU-1206-166). Dep. CFSTI.

The discussion of current algebra includes the Lehman–Symanzik–Zimmermann reduction formula, weak currents, two point functions, Weinberg sum rules, the PCAC hypothesis, the calculation of pole graphs, and pion–nucleon s-wave scattering lengths. The Adler–Weisberger relation, the $\rho \rightarrow 2\pi$ decay, universality of the rho coupling, eta decay, K decays, and nonleptonic hyperon decays are covered. Low-energy $\pi + N$ scattering, the Fubini method, the infinite-momentum method, neutrino and electromagnetic sum rules, and the Adler–Cabibbo–Radicati sum rule are discussed. Lastly, the backward scattering sum rule and some model-dependent results, and low-energy theorems for Compton scattering are considered. (J.F.P.)

16941 DESCRIPTION OF PARTICLES OF ARBITRARY SPIN. Mathews, P. M. (Univ. of Madras). Symp. Theor. Phys. Math., 6: 39-54(1968).

The new formulation for particles of arbitrary spin which stresses the particle aspect of the wave equations as represented by notions of mass and spin is reviewed against the background of conventional theories. (J.F.P.)

16942 WHAT ARE ELEMENTARY PARTICLES MADE OF. Sudarshan, E. C. G. (Syracuse Univ., N. Y.). Symp. Theor. Phys. Math., 6: 59-64(1968).

Various theories regarding the structure of elementary particles are reviewed. It is concluded that elementary particles are made of fields of Lie algebra. (J.F.P.)

16943 NON-LAGRANGE THEORIES AND GENERALIZED CONSERVATION LAWS. Takahashi, Yasushi (Dublin Inst. for Advanced Studies). Symp. Theor. Phys. Math., 6: 103-9 (1968).

Techniques for deriving conservation laws directly from equations of motion are reviewed and extended. (J.F.P.)

16944 SELECTED TOPICS IN CURRENT ALGEBRA. Pietschmann, H. (Univ., Vienna). pp 1-23 of Lectures in Theoretical High Energy Physics. Aly, H. H. (ed.). New York, John Wiley and Sons, Inc., 1968.

The method of current algebra is discussed and illustrated for the interaction of a proton with an external electromagnetic field. Two of the most important results of current algebra are pre-

sented, the derivation of the Adler–Weisberger sum rule and the application of the soft-pion method to leptonic K-decays. (L.B.S.)

Electromagnetic

Refer also to abstracts 16915 and 16957.

16945 (DESY-68/54) EQUAL TIME COMMUTATORS AND FORM FACTORS IN QUANTUM ELECTRODYNAMICS WITH INTERNAL SYMMETRY. Katz, J.; Langerholc, J. (Hamburg Univ. (West Germany). Institut fuer Theoretische Physik (II)). Oct. 1968. 50p. Dep.

The proposal that the equal-time limit of commutators of current operators could be abstracted from simple models and postulated as exact is explored. Some features of equal-time commutators between isospin currents are discussed in second-order perturbation theory, in particular their connection with form factors and renormalization. The quantum electrodynamical interactions of photons with electrons and nucleons is considered. (J.F.P.)

16946 (JINR-P2-4178) RADIATIVE CORRECTIONS TO π-e SCATTERING. PART II. Bardin, D. Yu.; Semikoz, V. B.; Shumeiko, N. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 17p. (In Russian). Dep.

The radiative corrections to π-e scattering were calculated for the experiment in which the energy and the angle of recoil meson are measured. While studying the diagrams with two virtual γ-quanta exchange and those connected with the meson peak renormalization, strong interactions were not taken into account. It was shown that the contribution of such diagrams does not exceed 1% in cross section, and it can be neglected if the account of strong interactions does not enlarge the contribution mentioned. In this case the electromagnetic form factor of π-meson can be taken into account in the cross section which includes the radiative corrections. It is shown, that the angle measurement error has the major role in the calculation of the radiation corrections. (auth)

16947 (MIT-2098-506) INCOHERENT DROPLET MODEL AND MULTIPARTICLE PRODUCTION IN ELECTRON-PROTON COLLISION. Huang, Kerson (Massachusetts Inst. of Tech., Cambridge). Dec. 1968. Contract AT(30-1)-2098. 10p. (CONF-681206-1). Dep. CFSTI.

From Symposium on Multiparticle Production, Argonne, Ill.

The incoherent droplet model is extended to photon-initiated reactions in particular electron–proton collisions through one-photon exchange. A model in which the proton is soft and one in which the proton is hard are described. (J.F.P.)

16948 EVALUATION OF MULTIPOLES FOR PHOTO- AND ELECTROPRODUCTION OF PIONS. II. NUMERICAL RESULTS FOR THE PHOTOPRODUCTION OF PIONS ON PROTONS. Schwela, D.; Weizel, R. (Univ., Bonn). Z. Phys., 221: 71-105 (1969).

The detailed results of an evaluation of the multipole amplitudes for photoproduction of pions on nucleons are presented. The dispersion relations for the multipoles E_{0+}, M_{1-}, M_{1+}, E_{1+}, E_{2-} and M_{2-} were solved by the Muskhelishvili-Omnès method using an appropriate ansatz for the inelastic multipole amplitudes. Four phenomenological parameters occurring in the theory were determined by a least squares fit of the π^0 experimental different cross section data. Except at pion CM-angles between 50 and 80° and at 180° in π^0 production there is satisfactory agreement between theory and experiment for all measured differential cross sections, polarizations and asymmetries of π^0- and π^+-photoproduction. (auth)

16949 ASYMPTOTIC PROPERTIES OF ELECTROPRODUCTION STRUCTURE FUNCTIONS. Abardanel, H. D. I.; Goldberger, M. L.; Treiman, S. B. (Princeton Univ., N. J.). Contract AF49(638)-1545. Phys. Rev. Lett., 22: 500-2(Mar. 11, 1969).

The joint implications of Bjorken and Regge asymptotics are discussed for the structure function of electroproduction. It is suggested that for $q^2 \to \infty$, the function νW_2 approaches a constant for large values of $\rho \equiv m\nu/q^2$. (auth)

16950 CP VIOLATION WITH AN INTERMEDIATE WEAK VECTOR BOSON. Gourishankar, R.; Kamal, A. N. (Univ. of Alberta, Edmonton). Can. J. Phys., 47: 693-5(Mar. 15, 1969).

A model of CP violation due to the existence of a neutral intermediate weak vector boson is studied. It is found that all leptonic and semileptonic decays are CP conserving; however nonleptonic decays are all CP violating to order $|\eta_{+-}|$. The CP-violating decays also preserve the $|\Delta I| = \frac{1}{2}$ rule. An estimate of the electric dipole moment of the nucleon based on such a model gives $\mu_c \approx 10^{-23}$ e cm. The electric dipole moment of the electron is zero. (auth)(Canada)

16951 ENERGY ESTIMATION OF ELECTRON PAIRS IN NUCLEAR EMULSIONS. Puri, R. K.; Aditya, P. K. (Indian Inst. of Tech., New Delhi). Indian J. Pure Appl. Phys., 7: 4-6 (1969).

A new empirical formula was obtained for the energy estimation of electron pairs from the opening angle of the pair for which 108 electron pairs of average energy 800 MeV were employed. A comparison was made with the dependence expected from the earlier theories. (auth)

16952 STUDIES OF NUCLEAR INTERACTIONS WITH $\Sigma_\gamma >$ 1000 GeV. Apanasenko, A. V.; Shcherbakova, M. N. (Leningrad Inst. of Physics). Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 372-3 (Mar. 1968). (In Russian).

Gamma quanta produced by nuclear interactions at high-energies were recorded in 1000 μm thick photoemulsions under a 3 cm layer lead. The interactions took place in a 40 $g \cdot cm^{-2}$ graphite block placed at 25 cm from the lead surface and measured at 10 to 12 km elevation for 20.1 hr. Ten events with a total γ quantum energy of $>1.5 \times 10^{12}$ eV were examined in a shower with a multicore structure. Transverse momenta determined in relation to the gravity center of the shower and in relation to the shower symmetry were equal to $(2.52 \pm 0.24) \times 10^8$ eV and $(2.56 \pm 0.26) \times 10^8$ eV/c, respectively. An analysis of separate nuclear interactions showed that the most energetic γ quantum removes $\frac{1}{3}$ to $\frac{1}{2}$ total energy of all γ quanta considering that isotropic distribution of lg tan θ indicates the existence of a fireball with $\gamma = 1.7 \times 10^3$; the mass of the events was found to be $\overline{M} = \Sigma E\pi^{ee} = 1.43 \pm 0.15$ for π^0-mesons and 4.3 BeV for all mesons. (R.V.J.)

16953 ON THE RELATIVISTIC EQUATION FOR PARTICLES WITH SPIN j IN THE 2[2j + 1]-COMPONENT FORMALISM. Bednar, M. (Inst. of Physics, Prague). Czech. J. Phys., 19: 1-16(1969).

The equation describing a relativistic particle with spin j and mass m by a 2[2j + 1] component wave function is derived using the method of boost transformations. The formalism developed allows one to find the wave functions satisfying the equation obtained and to construct the relativistically invariant quantities from these functions in an easy way. For the case of spin $\frac{1}{2}$ the unitary equivalence with earlier results is demonstrated. (auth)

16954 PSEUDOSCALAR CHARGE DENSITY. Coombes, Charles A. (Univ. of Calgary, Alberta). Can. J. Phys., 47: 71-3(Jan. 1, 1969).

It is shown that a true pseudoscalar charge density — a $\Psi^*\Psi$ which has opposite signs in two regions — can exist. This fact is accomplished by allowing a parity transformation, for which $p^*p = -1$, and by making the operation of hermitian adjoint differ by a minus sign in the two regions. The classical explanation is accomplished by requiring a change in the sign convention used in the two regions connected by the inversion process. (auth)

16955 . A KINEMATIC-AMBIGUITY-FREE TEST FOR A_1 AND B MESONS. Poe, Robert T.; Desai, Bipin R.; Kernan, Anne; Shepard, Harvey K. (Univ. of California, Riverside). Phys. Rev. Lett., 22: 551-4(Mar. 17, 1969).

The photoproduction reaction channel $\gamma n \to p\pi^+\pi^-\pi^-$ is suggested as a means to test whether the A_1 and the B mesons are genuine resonances or kinematic effects. Implications for the duality principle are discussed. (auth)

16956 DISPERSION SUM RULES FOR THE FORM FACTOR OF THE π MESON. Khalfin, L. A.; Shcherbin, Yu. P. (Steklov Mathematics Inst., Leningrad. Leningrad State Univ.). JETP Lett. (USSR) (Engl. Transl.), 8: 360-3(Nov. 20, 1968).

Translated from Zh. Eksp. Teoret. Fiz., Pis'ma Redaktsiyu, 8: 588-91(Nov. 20, 1968).

The dispersion sum rules are investigated for the form factor G(t) of the meson (π). In this case $t_0 = 4m^2$ and G(t) is real when $t < t_0$. In the dispersion relations obtained $\infty < t_2 < t_1 < 0$. The two dispersion relations obtained differ in the fact that when t_1 is suitably chosen it is possible to eliminate in them the region of very small t $E(t_1, 0)$, where G(t) is determined experimentally with low accuracy. In the derivation of the first dispersion relations a definite power-law limitation is imposed on the asymptotic form of G(t). The second derived dispersion relations are valid for all power-law asymptotic form of G(t) but it is assumed that G(t) does not have complex zeros. (J.F.P.)

Weak

Refer also to abstract 16944.

16957 (BNL-tr-243) REGENERATION PROCESS OF $K_1^0 \rightarrow K_2^0$ AT HIGH ENERGY. Okonov, E. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated by Stephen J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from report JINR-P1-3788. 10p. Dep. CFSTI.

A determination is made of the contribution of the $K_2^0 \rightarrow K_1^0$ regeneration at high energies in the investigation of the amplitude interference of the $K_2^0 \rightarrow \pi^+\pi^-$ and $K_1^0 \rightarrow \pi^+\pi^-$ decays. The asymptotic behavior of KN and $\overline{K}N$ scattering amplitudes, resonance states in the $\overline{K}N$ system, and the electromagnetic structure of the K^0 mesons are considered. (J.F.P.)

16958 (ITF-68-47) WEAK RADIATIVE DECAYS OF HYPERONS. Struminski, B. V. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1968. 6p. (In Russian). (CONF-680647-1). Dep.

From Conference on Composite Models of Elementary Particles, Kiev, USSR.

The pole model of weak radiative decays of hyperons is proposed. The decay rates are calculated using the standard current-by-current weak interaction hamiltonian. The results are in good agreement with the experiment. (auth)

16959 TEN YEARS OF THE UNIVERSAL V–A WEAK INTERACTION THEORY AND SOME REMARKS ON A UNIVERSAL THEORY OF PRIMARY INTERACTIONS. Sudarshan, E. C. G. (Syracuse Univ., N. Y.). pp 145-63 of Lectures in Theoretical High Energy Physics. Aly, H. H. (ed.). New York, John Wiley and Sons, Inc., 1968.

The development of the theory of beta decay prior to 1957 is briefly reviewed. The discovery of the V–A interaction and its present status are then discussed. A theory of universal primary interaction of particles including strong, electromagnetic, and weak interactions is outlined. (L.B.S.)

16960 RADIATIVE CORRECTIONS IN β-DECAY. Kaellen, G. (Univ. of Lund, Sweden). Symp. Theor. Phys. Math., 6: 55-8 (1968).

The actual value of the cutoff energy appearing in the standard formula for the radiative corrections in beta decay in the case of a pure vector interaction is considered using the knowledge of nucleon form factors obtained from electron–proton scattering. It is pointed out that the value of this cutoff energy can be calculated from a knowledge of certain experimentally observable functions. (J.F.P.)

Strong (General)

Refer also to abstracts 16992 and 17002.

16961 SOME ASPECTS OF THE QUARK MODEL FOR HADRONS. Riazuddin (Univ. of Islamabad, Rawalpindi, Pakistan); Sarker, A. Q. pp 231-83 of Lectures in Theoretical High Energy Physics. Aly, H. H. (ed.). New York, John Wiley and Sons, Inc., 1968.

The electromagnetic and strong decays of hadrons are discussed and the cross-section relations at high energies are derived within the quark model. The double scattering corrections are evaluated. The quark model is the one used to abstract the algebraic properties for certain operators which are in principle measurable. The SU(6) algebra of Gell–Mann is discussed. It is shown that a uniform picture of Gell–Mann–Okubo mass splittings can be obtained in any SU(3) multiplet in terms of a more or less uniform mass-splitting parameter for every SU(3) multiplet. Nonleptonic hyperon decays, $K \rightarrow 2\pi$, and $K \rightarrow 3\pi$ decays are also discussed based on the quark model and using the results of current algebra. (L.B.S.)

Strong (Baryon No. = 0)

16962 ON THE BOSONS OF ZERO BARYON NUMBER AS BOUND STATES OF QUARK–ANTIQUARK PAIRS. Uretsky, J. L. (Argonne National Lab., Ill.). pp 285-314 of Lectures in Theoretical High Energy Physics. Aly, H. H. (ed.). New York, John Wiley and Sons, Inc., 1968.

A simple independent quark model of hadrons is presented without the a priori imposition of any symmetry other than isospin. Only the bosons of zero baryon number are considered, it is supposed that these have wavefunctions that are primarily made up of quark-antiquark pairs. The mass relations within the boson multiplets are examined in this model. Strong decays of mesons are discussed. Mass differences of the charged and neutral π and ρ mesons are also discussed. (L.B.S.)

16963 AN EXTENSION OF THE VENEZIANO REPRESENTATION. Neville, Donald E. (Temple Univ., Philadelphia). Phys. Rev. Lett., 22: 494-7(Mar. 10, 1969).

Veneziano's representation is extended from $\pi\pi \rightarrow \pi\omega$ to $\Pi\Pi \rightarrow \Pi V$, where Π (V) is a pseudoscalar (vector) SU(3) octuplet or singlet. (auth)

16964 THE A_1 AND K**(1320) PHENOMENA: KINEMATIC ENHANCEMENTS OR MESONS. Goldhaber, Gerson; Goldhaber, Sulamith (Univ. of California, Berkeley). Symp. Theor. Phys. Math., 6: 193-243(1968).

The similarity down to some very fine details between the A_1 phenomenon and the more recently discovered K**(1320) is discussed. It is pointed out that the similarity is truly remarkable and can hardly be coincidental. The pros and cons are presented for the assignments of kinematic enhancement or meson to the A_1 and K**(1320) respectively. It is concluded that much more data will be required before the presence of bona fide mesons can be either established or completely ruled out. (J.F.P.)

Strong (Baryon No. = 1)

Refer also to abstracts 16932 and 17131.

16965 (CEA-CONF-1240) POLARIZATION EXPERIMENTS AT HIGH ENERGY. Sonderegger, P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [1968]. 50p. (CONF-681045-1). Dep.

From International School of Elementary Particle Physics Conference, Herceg Novi, Yugoslavia.

Restriction is made to proper polarization phenomena, that is, those which give rise to experimentally observable asymmetries. Reactions of the type $0\ \frac{1}{2} \rightarrow 0\ \frac{1}{2}$ are considered almost exclusively. A few representative experiments are analyzed in detail from the point of view of the method used and the experimental problems on one hand and the results on the other. These results are discussed in the light of the Regge pole model. (J.F.P.)

16966 (INR-P-927) LAMBDA-NUCLEON INTERACTION. Deloff, A. (Institute of Nuclear Research, Warsaw (Poland)). 1968. 85p. Dep.

Theoretical aspects of ΛN interaction are reviewed. The problem of the origin of the ΛN forces and the field theoretical derivation of ΛN potentials are discussed in great detail. The model calculations surveyed include the phenomenological potential analysis, the Brueckner–Watson two-pion exchange approach, and the one-meson-exchange model. (auth)

Strong (Baryon No. ≥ 2)

16967 (N-68-33548) A PROGRAM TO CALCULATE PARTICLE SPECTRA PRODUCED IN HIGH-ENERGY PROTON–PROTON COLLISIONS BY THE TWO-TEMPERATURE STATISTICAL MODEL. Wayland, J. R. (Maryland Univ., College Park. Dept. of Physics and Astronomy). June 1968. 19p. (NASA-CR-96317; TR-844). CFSTI.

It is pointed out that the main assumption of the two-temperature model is that there are two characteristic temperatures associated with each type of particle produced. The transverse momentum distribution (T_0) describes the natural thermal motion of a hot interaction region, and gives a transverse momentum distribution independent of the incident energy. However, T_0 will be different for different mass particles. The longitudinal momentum distribution (T) is considered as the quasi-equilibrium condition at which the various particles boil off as the interaction volume cools: T is greater than T_0 as it includes the effect of the collective motion of the interacting gas along the direction of the incoming nucleon. The input parameters for the FORTRAN program are listed, and the values of the fixed parameters for the π^+, π^-, K^+, K^-, p, and p^- spectra are given. Also listed is the program for computing energies greater than 1000 GeV. (auth)

16968 OPTICAL POTENTIAL FOR HIGH ENERGIES. Weigel, M. (Univ., Munich); Mack, D. Z. Naturforsch., 23a: 1888-93(Dec. 1968). (In German).

An elementary derivation of the optical potential for high energies is given. For the determination of the optical potential only the knowledge of the scattering amplitude for free nucleons and of the autocorrelation function for density fluctuations is necessary. The numerical calculation of the real and imaginary part of the optical potential was performed using the Tabakin potential. (auth)

16969 HIGH-ENERGY pp SCATTERING AND PROTON SUBSTRUCTURE. Islam, M. M. (Univ. of Connecticut, Storrs); Rosen, Joe. Phys. Rev. Lett., 22: 502-5(Mar. 10, 1969).

A proton substructure model proposed earlier is used to analyze present data on high-energy pp angular distributions. The model satisfactorily describes differential cross sections over the entire momentum range 5 to 21 GeV/c and over the whole angular interval

0 to 90°, thus indicating existence of two hadronic core distributions of the proton. (auth)

16970 TRANSCRIPTION OF A QUASI PARTICLE IN IDEAL SPACE AND THE METHOD OF BOSONS. Simard, P. A. (Institut de Physique Nucleaire, Orsay, France). Can. J. Phys., 47: 103-11(Jan. 1, 1969). (In French).

A transcription of the quasi-particle into the ideal space is written in such a way that all the terms which contribute for the three quasi-particles system in quasi-particle Tamm–Dancoff approximation can be found. Canonical transformations between the ideal quasi-particles are studied. An application to one shell is done with the result that the boson method gives exactly the same spectra as the Kuo method. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 16939 and 17004.

16971 (JINR-P2-4203) CONFORMAL GROUP REPRESENTATIONS AND RELATIVISTIC FUNCTIONS WITH SPIN. Truskova, N. F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1968. 23p. (In Russian). Dep.

The conformal group representations were found which are diagonal in the Poincare group and in the uniform Lorentz group for the case of particle mass m = 0 and any spin S. The functions were constructed which are basis functions of the 0(4,2) group and of its subgroups: $0(4,2) < P(3,1) < L(3,1) < 0\ (3) < 0\ (2)$. These functions satisfy the massless Weinberg equations for any spin S and are reduced to the Berestetsky functions when $\rho = 0$. (auth)

16972 ON LOCALLY ISOMORPHIC GROUPS AND CARTAN–STIEFEL DIAGRAMS. Gruber, B. (Istituto Nazionale di Fisica Nucleare, Naples). Symp. Theor. Phys. Math., 6: 1-25(1968).

The semisimple compact and connected Lie groups are reviewed. Given such a group, all the (semisimple compact connected Lie) groups which are locally isomorphic to it are determined. The relations which hold among the members of such a set of groups, called a family, are given, i.e., the relations between a group, its covering groups, and its universal covering group are established. For the semisimple compact connected Lie groups, diagrams can be derived—the Cartan–Stiefel diagrams. The relations between these diagrams and the results stated for the families of locally isomorphic groups are established. All proofs are omitted and an intuitive argumentation is used. (J.F.P.)

16973 FERMION OPERATOR REALIZATION OF SU GROUP REPRESENTATION. Kim, Yongduk. J. Korean Phys. Soc., 1: 48-50(Mar. 1968).

Fermion operators are employed to realize the irreducible representation for SU_2 group a la Biedenharn. It turns out the normalization factors for basis states are notably easier to obtain in comparison with the boson realization. Matrix elements for the group generators are also obtained. (auth)

16974 THEORY OF SYMMETRY VIOLATION AND GRAVITATION. Moffat, J. W. (Univ. of Toronto). pp 423-34 of Lectures in Theoretical High Energy Physics. Aly, H. H. (ed.). New York, John Wiley and Sons, Inc., 1968.

A theory of the violations of internal symmetry groups and the gravitational field is developed on the basis of a non-Riemannian displacement field. Divergence equations for the vector and axial vector current densities in weak interactions are derived. The equations show that if the groups U(3) and U(3) × U(3) are considered in a non-Riemannian space-time, then the group generators are not constants of the motion. Field equations for the non-symmetric fields are found, and in a weak field approximation vector and axial vector current sum rules are obtained from the divergence equations. (L.B.S.)

16975 THE DISCRETE SYMMETRIES P, C, AND T. Nilsson, J. (Inst. for Theoretical Physics, Goteberg). pp 61-144 of Lectures in Theoretical High Energy Physics. Aly, H. H. (ed.). New York, John Wiley and Sons, Inc., 1968.

The basic formalism underlying invariance principles is briefly reviewed. In this context the concept of symmetry is introduced and some of the immediate implications which follow from invariance principles are derived. The theory and experimental situation on space reflection and parity, charge conjugation, CP transformation, time reversal, and the CPT transformation are discussed in detail. (L.B.S.)

16976 PC AND T VIOLATION. Taylor, J. G. (London Univ.). pp 25-49 of Lectures in Theoretical High Energy Physics. Aly, H. H. (ed.). New York, John Wiley and Sons, Inc., 1968.

A brief survey is given of the experimental results on violations or limits of violation for each of the discrete symmetries P, C, T and their various pairwise combinations, and of PCT. The problem of defining discrete symmetry operators such as P, C, or T when they are not exact symmetries of the physical system is discussed. The manner in which the discrete operators can be regarded as symmetry operators is related to the concept of reciprocity, based on the relation between moduli of expectation values. The use of reciprocity to describe the violations of C, P, and T or their combinations is discussed. The magnetic monopole theory of CP violation is discussed in the final section. (L.B.S.)

16977 FERMION OPERATOR REALIZATION OF SU_3 GROUP REPRESENTATION. Kim, Yongduk. J. Korean Phys. Soc., 1: 103-7(Oct. 1968).

An irreducible representation for the SU_3 group is realized by Fermion creation and annihilation operators. The bases states are obtained and the corresponding Young diagrams are indicated. The present method can be directly extended to the irreducible representation of the other SU_n groups. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 16921 and 16982.

16978 VIOLATION OF CP-INVARIANCE IN WEAK ELECTROMAGNETIC AND MINIWEAK PARITY CONSERVING INTERACTIONS. Arbuzov, B. A.; Filippov, A. T. (Joint Inst. for Nuclear Research, Dubna, USSR). JETP Lett. (USSR) (Engl. Transl.), 8: 302-5(Nov. 5, 1968).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Redaktsiyu, 8: 493-6(Nov. 5, 1968).

A class of models of CP violation is discussed in which the direct CP-odd transitions $K_2 \to 2\pi$ are small compared with the transitions $K_2 \to K_1 \to 2\pi$ induced by CP nonconservation in the mass matrix. These models are characterized by the condition $|\epsilon_2| \ll |\epsilon_0|$. This condition follows from the parity selection rules in the minimal models considered. (J.F.P.)

16979 TIME REVERSAL AND THE K^0 MESON DECAYS. II. Casella, R. C. (National Bureau of Standards, Washington, D. C.). Phys. Rev. Lett., 22: 554-6(Mar. 17, 1969).

Current data on the decay $K^0 \to 2\pi$ are used to extend the results of an earlier analysis testing these reactions for T invariance irrespective of CPT symmetry. The extended analysis together with recent work on pion production data allow one to establish that T is not conserved in these decays. (auth)

Applications (Strong)

16980 (NP-17780) SU(3)''-EXCITATION IN BARYON RESONANCES. Topical Report No. 868. Nelson, Charles A. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Aug. 1968. 77p.

The possible existence of a second SU(3) degree of freedom, called SU(3)'', in particle physics is investigated: Using the three-triplet model and the unique assignments in this model for N(1466), Z_0(1863), and Z_1(1910) the entire three-particle antisymmetric representation 816 of SU(18) is predicted. Among the predictions are the masses of Z_1(2190) and Z_1(2280), and the masses and J^P of $N(1751)1/2^+$, $N(1863)3/2^+$ and $\Delta(1934)1/2^+$, which are in good agreement with experiment. The SU(18) mass formula giving these predictions is derived. Selection rules for allowed decays of SU(3)''-excited baryon resonances are given using a new classification for mesons. Mixing effects due to the $SU(8) \times U(1)_N$ chain are studied. Recoupling coefficients relating SU(3) multiplets in this chain to those in the SU(3)' × SU(3)'' chain are listed. The s^3 spatial configuration nucleonic resonances such as N(1466) and N(1751) should be produced with even sharper forward peaking than the corresponding elastic process. Present limits on backward K^-p elastic scattering are compatible with u-channel exchange of Z_1(1910). Using chiral current algebra the SU(6) mass formula for the 56 plet of SU(6) is rederived. (auth)

16981 SPONTANEOUS BREAKDOWN OF CHIRAL SU(3) ⊗ SU(3) SYMMETRY. Cicogna, G. (Univ., Pisa, Italy); Strocchi, F.; Caffarelli, R. Vergara. Phys. Rev. Lett., 22: 497-9(Mar. 10, 1969).

It is shown that the Hamiltonian suggested by Gell-Mann, Oakes, and Renner can be obtained as a spontaneous breakdown of chiral SU(3) ⊗ SU(3) symmetry. (auth)

16982 RELATIVISTIC EXTENSIONS OF SU(6). Ruegg, H. (CERN, Geneva). Symp. Theor. Phys. Math., 6: 261-70(1968).

The discussion of relativistic extensions of SU(6) covers unitary

representations of the Poincaré group, the hierarchy of groups, and the inhomogeneous approach in which one assumes that the scattering operator is invariant under the full inhomogeneous group but that the states are restricted by the supplementary condition that only the four physical momentum operators have nonvanishing eigenvalues. It is shown that the S-matrix elements obey exactly the hierachy of groups so that these two approaches are actually equivalent. (J.F.P.)

Field Theories

General

Refer also to abstract 16939.

16983 TEMPERATURE IN SPECIAL RELATIVITY. Lindhard, J. (Univ. of Aarhas, Denmark). Physica, 38: 635-40 (June 5, 1968).

It is shown from basic thermodynamics that temperature and entropy are invariant in special relativity. Ambiguities have arisen from adherence to the idea of transfer of "heat"; it is preferable to use only quantities like energy and entropy, for which conservation laws apply. (auth)

Quantum Field Theory

Refer also to abstracts 16945 and 16953.

16984 (TF-68-59) GREEN FUNCTION EQUATIONS IN QUANTUM ELECTRODYNAMICS. Petrina, D. Ya.; Rebenko, A. L. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1968. 42p. Dep.

Problems of quantum electrodynamics are dealt with. Two types of equations for the Green function, which are considered as S-matrix elements, are obtained. The equations of the first type are derived from the Schwinger equations; their iteration produces no vacuum loops. In the framework of perturbation theory, these equations correspond to those for the S-matrix elements which are obtained after cancellation of the contributions from vacuum diagrams. The equations of the second type correspond exactly to the S-matrix represented by the T-exponential; on their interaction the vacuum loops arise. The linear operator determining the second type of equations is formally symmetrical while the linear operator for the equations of the first type is not symmetrical. Reported at the Seminar in Institute for Theoretical Physics, Kiev, Ukrainian SSR. (auth)

16985 (NYO-1932(2)-145) POSSIBLE WAY TO REMOVE DIVERGENCE DIFFICULTIES IN PHYSICS. Lee, T. D. (European Organization for Nuclear Research, Geneva (Switzerland)). Feb. 1969. Contract AT(30-1)-1932. 38p. (CONF-690107-2). Dep. CFSTI.

From International Conference on Weak Interactions, Geneva, Switzerland.

The discussion of divergence difficulties in physics covers divergence difficulties in electrodynamics, and in the weak interaction, a possible solution to the divergence problem, and unitarity. A soluble model is given as an example, and quantum electrodynamics without divergence difficulties and modified Feynman rules are discussed. Lastly, possible experimental tests are considered. It is concluded that without some fundamental changes the divergences cannot be removed from quantum field theory. But the introduction of a negative metric and the possible existence of complex singularities may provide a way out of these difficulties. (J.F.P.)

16986 NORMALIZATION OF BETHE-SALPETER WAVE FUNCTIONS. Takahashi, Yasushi (Dublin Inst. for Advanced Studies). Symp. Theor. Phys. Math., 6: 97-101(1968).

The problem of normalization of wave functions for the elementary particle is summarized. (J.F.P.)

16987 FIELD THEORETIC FUNCTIONAL CALCULUS FOR THE ANHARMONIC OSCILLATOR IN LOW APPROXIMATIONS. Schuler, Wolfgang (Univ., Tuebingen, Ger.). Z. Naturforsch., 23a: 1869-87(Dec. 1968).

The theory of solution for quantum field functional equations as developed for a suitable test problem of quantum mechanics is investigated in low approximations. The functional formulation of the anharmonic oscillator is once more given and general translational equivalent functional equations. The expansion of the physical state functional into series of unsymmetrical and symmetrical base functionals and the representation of the functional equations for such expansions are discussed. The unsymmetrical Dyson representation is investigated and the explicit representation of the smeared out functional equation by an infinite system of equations is derived. Then the system of equations is truncated for N = 3 and the corresponding eigenvalue equation is considered. The same is done for the Hermite representation. The original functional equation in a not smeared out form is treated in the Dyson representation and the corresponding system of unsymmetrized equations is given. Furthermore the N = 3 approximation together with other possibilities is investigated again. Finally the numerical results of calculations for eigenvalues are stated and discussed. Technical details are derived. (auth)

16988 SPECTRAL REPRESENTATION IN CONNECTION WITH SCHWINGER TERMS. Burnel, A. (Univ., Liege). Physica, 38: 333-40(Apr. 5, 1968).

The Lehmann-Källen representation shows that Schwinger terms must appear in the commutation relations between spatial and time components of any four vector operator with four hermitian components. These Schwinger terms disappear from the expectation values of the commutator $[O_\mu(x), O_\nu(y)]$ when the time component of the four vector is anti-hermitian while the spatial components are hermitian for the ordinary scalar product. An application of these considerations concerns the free electromagnetic field theory, where such hermiticity conditions are used in the Gupta-Bleuler method. (auth)

16989 ONE CLASS OF REPRESENTATION OF CANONICAL, COMMUTATIVE RELATIONS (CCR) OF QUANTUM FIELD THEORY. Zav'yalov, O. I.; Sushko, V. N. Dokl. Akad. Nauk SSSR, 183: No. 1, 56-9(Nov. 1, 1968). (In Russian).

Tensor product representations of a mathematical family of Gilbert spaces, in each of which a Schroedinger representation CCR is realized for a single degree of freedom, are called direct multiplying representations (DMR), and are of interest for calculating purposes. A series of results on the structure of the DMR are formulated, and their place in the classification scheme of Garding and Wightman is given. The results can also be transposed with obvious modifications to the case of canonical, anticommutation relations. (TTT)

16990 COMPOSITENESS CRITERIA IN FIELD THEORY. Hagen, C. R. (Univ. of Rochester, N. Y.). pp 165-97 of Lectures in Theoretical High Energy Physics. Aly, H. H. (ed.). New York, John Wiley and Sons, Inc., 1968.

An attempt is made to formulate the compositeness criteria within the framework of Lagrangian field theory. The approach is based on results previously obtained in the Lee model, where, in the limit, the wave-function renormalization constant of the V particle tends to zero. (L.B.S.)

16991 TOPICS IN BOUND STATE THEORY. Lurie, D. (Dublin Inst. for Advanced Study). pp 199-229 of Lectures in Theoretical High Energy Physics. Aly, H. H. (ed.). New York, John Wiley and Sons, Inc., 1968.

Three topics are discussed: field operators for composite particles, Bethe-Salpeter wave functions; and the $Z_3 = 0$ condition for composite bosons. (L.B.S.)

16992 BOOTSTRAPS AND THEIR FIELD QUANTIZATION. Taylor, J. G. (London Univ.). pp 51-60 of Lectures in Theoretical High Energy Physics. Aly, H. H. (ed.). New York, John Wiley and Sons, Inc., 1968.

A field theoretic approach to composite particles is first reviewed. An extension is then made to a bootstrapped system having the wave function renormalization constants of all the particles set equal to zero. Various methods of quantization are discussed in order to determine which possible system can bootstrap each other. It is found that a nontrivial bootstrap can only be obtained for derivative systems. The existence of certain conserved quantum numbers for some systems of this type and their relation to bootstrapped symmetries are discussed. (L.B.S.)

16993 THE QUANTIZED CAUCHY DATA AND PARTICLE STATES FOR THEORIES WITH HIGHER-ORDER DERIVATIVES. Cukierda, T.; Lukierski, J. (Univ. of Wroclaw). Acta Phys. Pol., 34: 913-28(Nov. 1968).

The quantized Cauchy data for symmetrized covariant bilinear Lagrangians, containing derivatives up to 2N-th order, are investigated. The unitarily inequivalent generalized canonical spaces with indefinite metric, defined by means of quantized Cauchy data, and the particle states are introduced. The particle states are defined as the eigenstates of the four-momentum operator. In the presence of multipoles they describe only a subspace of generalized canonical space. The complement of the particle space defines the subspace of ghost states. Finally the subsidiary condition and η-formalism for higher order Lagrangians are considered. (auth)

16994 CONVERGENCE OF THE PERTURBATION SERIES IN A MODEL OF QUANTUM FIELD THEORY. Niederer, Ul-

rich H. (Univ., Bern). Helv. Phys. Acta, 42: 255-8(Apr. 1, 1969).

The behavior of the vacuum expectation value of a regularized scalar field operator is studied as a function of the coupling constant μ^2 in the Fierz model. The vacuum expectation value exhibits an essential singularity at $\mu^2 = 0$. Therefore, the perturbation series diverges, representing only an asymptotic expansion of the vacuum expectation value under consideration. (auth)

Gravitation and General Relativity

Refer also to abstracts 16621, 16919, and 16974.

16995 (N-68-33375) ON A PERIODIC SOLUTION OF THE CENTRAL DIFFERENTIAL EQUATION IN THE RELATIVITY THEORY OF GRAVITATION. Ghaffari, Abolghassem (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). [1968]. 4p. (CONF-680835-1). CFSTI.

From 12th International Congress of Applied Mechanics, Stanford, Calif.

An investigation was conducted on the application perturbation techniques to the central differential equation in the relativity theory of gravitation. Assuming the earth's gravitational field is spherically symmetric and the effect of the gravitational field of the sun on an artificial earth satellite is negligible; then the motion of an artificial earth satellite is governed by the ordinary geodesics of the Schwarzschild metric. An approximate periodic solution of the satellite orbit is obtained and it is shown that the frequency of the approximate solution is a function of the amplitude and eccentricity of the corresponding Keplerian orbit. (auth) (STAR)

16996 ON A CLASS OF NON-STATIC FLUID SPHERES WITHOUT ENERGY FLOW. Nariai, Hidekazu (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto), 40: 1013-22(Nov. 1968).

In order to find some common features of relativistic fluid spheres without energy flow, the velocity field in the fluid spheres is examined from the standpoint of its covariant decomposition. The examination shows that, if the velocity field is shear-free, its 4-divergence depends only on time and the converse is also true. It is also shown that the fluid spheres without energy flow dealt with recently are all shear-free. (auth)

16997 SPACE-TIME GENERAL EINSTEINIAN GRAVITATIONAL SHOCKS. Choquet-Bruhat, Y. (Institut Henri Poincare, Paris). Ann. Inst. Henri Poincare, Sect. A, 8: 327-38 (1968). (In French).

A very broad definition is given of space-time so that the basic principles of general relativity are respected and the Einstein equations have meaning in the framework of the theory of distributions. The strong regularity conditions are given so that the Cauchy problem (local) has only one solution. A particular case of space-time thus defined is that of space-time having gravitational shocks. The equations of these shocks are written in an intrinsic form at the passage of a hypersurface S which is assumed only lipschitzian. It is shown that the four conditions verified during such a shock through a characteristic variety expresses the continuity of the harmonic conditions. This last result makes it possible to show the uniqueness of the prolongation of a space-time through a characteristic cone even if the cone is the gravitation shock wave surface. (tr-auth)

16998 SUPERSPACE AND THE NATURE OF QUANTUM GEOMETRODYNAMICS. Wheeler, J. A. pp 615-724 of Topics in Nonlinear Physics. Zabusky, Norman J. (ed.). New York, Springer-Verlag New York, Inc., 1968.

Quantum geometrodynamics and superspace are described. Three-dimensional space, superspace, wave packets in superspace, the limited validity of space-time, and the Planck length and gravitational collapse are discussed. Quantum fluctuations in the geometry of space, fluctuations superposed on a classical background, the extrapolation of geometrodynamics to the Planck scales of distances, and electricity as lines of force trapped in the topology of space are considered. Also considered are the energy of the vacuum, a particle as a geometrodynamical exciton, the derivation of the Einstein-Hamilton-Jacobi equation, the structure of superspace, and the fixed topology exclusion of geometrodynamics account of particles and fields. Lastly, field formalism, orientation, alternative spin structures in a multiply connected space, the multisheeted character of superspace, electromagnetics, 2-geometries, and tangent vectors and initial conditions are covered. (J.F.P.)

16999 ASYMPTOTIC BEHAVIOR OF THE CURVATURE TENSOR ON AN ASYMPTOTICALLY FLAT SPACE-TIME. Lehman, Eric (Faculte des Sciences, Paris). Ann. Inst. Henri Poincare, Sect. A, 9: 213-71(1968). (In French).

Having defined asymptotically flat space-time, the limited development of the curvator tensor R: $R = \overset{1}{R}r^{-1} + \overset{2}{R}r^{-2} + \overset{3}{R}r^{-3} + \overset{4}{R}r^{-4} + o(r^{-4})$, (or the Weyl-tensor C) is studied. It is proven that some simple conditions are equivalent to "$\overset{1}{R}$ is a N-case" (or III, or II) of the Bel-Petrov classification or ($\overset{2}{R}$ is a III-case) (or II) and so on ... In particular the Sachs peeling theorem is proven with much less hypotheses, without intergrating the field equations (and without circular functions). Finally, the model (pure electromagnetic field) is studied as an example of such an asymptotically flat space-time. (auth)

17000 NULL ELECTROMAGNETIC FIELDS IN ALGEBRAICALLY SPECIAL PETROV TYPE SPACES. Kichenassamy, S. (Institut Henri Poincare, Paris). Ann. Inst. Henri Poincare, Sect. A, 9: 273-81(1968).

An analysis is made of the properties of the null congruence C(k) tangent to the multiple principal null vector k^α of the Weyl tensor $C_{\alpha\beta\gamma\delta}$ when: (a) the field of null vectors k^α is given and not a field of null tetrads associated with k^α; (b) the Robinson-Schild type conditions on $C_{\alpha\beta\gamma\delta}$ and not on $C_{\alpha\beta\gamma\delta} = C_{\alpha\beta\gamma\delta} + iC^*_{\alpha\beta\gamma\delta}$, are postulated, (c) it is assumed that k^α is at the same time the principal null vector of a null electromagnetic field. It is shown that the shear-free character of C(k) resulting from the generalized Goldberg-Sachs theorem must then be qualified. (auth)

17001 CAUCHY PROBLEM FOR GENERAL RELATIVITY EQUATIONS IN THE SCHEMES OF PERFECT FLUID AND PURE MATTER. Caricato, Gaetano (Univ., Rome). Ann. Inst. Henri Poincare, Sect. A, 9: 283-301(1968). (In French).

The Cauchy problem for the Einstein equations is considered in the interior cases where the stress tensor of a perfect fluid or pure matter is present. It is shown that the Cauchy problem breaks into two separate invariant problems: the problem of initial conditions, the restricted problem of evolution. For the restricted problem of evolution two theorems of existence and unicity are established: with the assumption of analytic data for a perfect fluid; without any assumption of analyticity for a system of pure matter. (auth)

Scattering Theory

Refer also to abstract 16939.

17002 (JINR-E2-4251) RELATIVISTIC QUASIPOTENTIAL MODEL OF PARTICLE SCATTERING AT HIGH ENERGIES. Garsevanishvili, V. R.; Matveev, V. A.; Slepchenko, L. A.; Tavkhelidze, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1969. 10p. Dep.

A relativistic model of high-energy elastic scattering is considered on the basis of the quasipotential equation in quantum field theory. The behavior of the scattering amplitude for small and large momentum transfers is investigated. (auth)

17003 ANOMALOUS THRESHOLD SINGULARITIES IN S-MATRIX THEORY. Goddard, P. (Univ. of Cambridge, Eng.). Nuovo Cim., 59A: 335-53(Feb. 1, 1969).

The singularity of anomalous thresholds of connected S-matrix elements outside the physical region is discussed. In some specific cases the positive α-condition for singularity is shown to be equivalent to the requirement that the discontinuity round each threshold be given by a Cutkosky integral with a "flat" integration counter. This "flatness" requirement, the meaning of which is explained, implies a correspondence between distortions of extended unitarity integrals and the singularity of anomalous thresholds. In the simplest cases the proof of its equivalence to the positive α-condition is direct, but in a more complicated case a delicate cancellation between distortion terms from different extended unitarity integrals has to be proved to establish the result. (auth)

17004 GROUP INTERPRETATION OF THE COMPLEX SPIN. Roginskii, V. I. JETP Lett. (USSR) (Engl. Transl.), 8: 269-72(Oct. 20, 1968).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 8: 437-40(Oct. 20, 1968).

The polarization matrix of a particle with complex spin is considered. A group interpretation of the complex spin is necessary since it is possible that these particles, which have properties that exclude their direct observability, may serve as material for the construction of real particles. (J.F.P.)

17005 ON FUNCTIONAL METHODS IN THE S-MATRIX THEORY. Rzewuski, Jan (Univ., Wroclaw). Symp. Theor. Phys. Math., 6: 163-75(1968).

The functional method in S-matrix theory consists in replacing

the set of probability amplitudes by the corresponding generating functional and in formulating the basic postulates of the theory in terms of this functional or of its off mass shell generalizations. The case of scattering of neutral spinless particles with mass m is considered. (J.F.P.)

17006 IMPACT PARAMETER FORMALISM. Kotani, Tsuneyuki (MATSCIENCE, Madras). Symp. Theor. Phys. Math., 6: 177-87(1968).

An impact parameter representation of the scattering of two spinless distinguishable particles is discussed. (J.F.P.)

17007 INELASTIC N/D EQUATIONS AND REGGE THEORY. Warnock, R. L. (Argonne National Lab., Ill. Illinois Inst. of Tech., Chicago). pp 315-50 of Lectures in Theoretical High Energy Physics. Aly, H. H. (ed.). New York, John Wiley and Sons, Inc., 1968.

The inelastic N/D equation is derived, and a generalized form of Levinson's theorem is proved. A new and possibly advantageous method of handling the Castillejo–Dalitz–Dyson poles is described. The behavior of partial waves at infinity in Regge theory is studied. A Regge behavior modified by logarithmic factors is also considered. The Fredholm character of the N/D equations is demonstrated. A description is given of a tentative proposal for dynamical calculations with Regge exchange. Some attention is given to direct channel resonances which can be introduced through CDD poles when the resonances are not dynamically generated by the trajectory exchange mechanism. The discussion throughout is for the case of zero spin, equal mass scattering. (L.B.S.)

17008 SOME ASPECTS OF HIGH ENERGY POTENTIAL SCATTERING. Aly, H. H. (American Univ. Beirut). pp 351-69 of Lectures in Theoretical High Energy Physics. Aly, H. H. (ed.). New York, John Wiley and Sons, Inc., 1968.

Various problems arising in the relativistic scattering of hadrons are discussed in the context of nonrelativistic scattering by regular and singular potentials. Upper bounds on partial wave amplitudes are first given. Some general criteria are given for writing down dispersion relations for the two-particle scattering amplitude due to singular potentials. Some analyticity aspects of the residue function of the Regge poles are briefly discussed, both in the case of regular and singular potentials. Regge trajectories for the potential r^{-4} are also briefly discussed. (L.B.S.)

17009 PERTURBATION APPROACH FOR REGULAR INTERACTIONS. Mueller, H. J. W. (Univ., Munich). pp 371-421 of Lectures in Theoretical High Energy Physics. Aly, H. H. (ed.). New York, John Wiley and Sons, Inc., 1968.

A first attempt is made to present a unified picture of a perturbation treatment of almost any type of non-singular interaction. The introductory section is devoted to the mathematical method. In the following sections the method is applied to perturbed Coulomb interactions and to perturbed harmonic oscillators. (L.B.S.)

17010 MODEL FOR THE POMERANCHUK TERM. Freund, Peter G. O. (Univ. of Chicago). Phys. Rev. Lett., 22: 565-8 (Mar. 17, 1969).

A model of the Pomeranchuk term as a sum over two-body intermediate states is constructed. Experimental tests involving resonance production are suggested. (auth)

17011 ON THE ANALYTICITY PROPERTIES OF THE N-BODY SCATTERING AMPLITUDE IN NON-RELATIVISTIC QUANTUM MECHANICS. Riahi, F. (Eidgenoessiche Technische Hochschule, Zurich). Helv. Phys. Acta, 42: 299-329(Apr. 1, 1969).

The scattering of N nonrelativistic spinless, distinguishable particles interacting via two-body superpositions of Yukawa potentials is considered. The on-energy-shell amplitude is studied as a function of the total center-of-mass kinetic energy E and for physical values of the 'angular' variables $x_i = (1\ k)p_i$, $y_i = (1/k)q_i$, $1 \le i \le N$, $k^2 = E$, where $p_1 \ldots, p_N$ and $q_1, \ldots q_N$ are the initial, respectively the final momenta. It is shown that this amplitude is the boundary value of a function analytic in the energy E in a complex plane cut from $-\infty$ to $-\rho^2$ for some $\rho > 0$ and from 0 to $+\infty$ and in all variables $(x_1 \ldots, y_N)$ in a neighborhood of their physical values, up to an algebraic set of codimension 1. (auth)

Particle Accelerators

Refer also to abstracts 16133, 16853, 16939, and 17107.

17012 (AERE-R-5846) THE BEAM TRANSPORT SYSTEM OF THE HARWELL VARIABLE ENERGY CYCLOTRON. Barnfield, R. W. (Atomic Energy Research Establishment, Harwell (England)). Sept. 1968. 37p. Dep. CFSTI. UK 7s.

A description is given of the beam transport system of the Variable Energy Cyclotron. Investigations using the analog computer which furnished beam transport solutions for the initial commissioning of the beam transport system and the development of later particle beams are discussed. The design and commissioning of beam steering and scanning systems are also described. (auth)

17013 (BNL-13266) LONGITUDINAL INSTABILITIES IN SYNCHROTRONS AT TRANSITION. Pease, Robert L. (Brookhaven National Lab., Upton, N. Y.). Dec. 18, 1968. 18p. Dep. CFSTI.

In a previous investigation of longitudinal instabilities at transition, the analysis was carried out using solutions which did not hold at transition. This analysis is modified by using the much more accurate fractional-order Bessel function solutions of Courant and Snyder. For the AGS, under conditions which might lead to instability, the difference in predicted instability behavior appears to be negligible, and the cruder theory suffices for this purpose. (auth)

17014 (CEA-CONF-1229) SACLAY ELECTRON LINEAR ACCELERATOR. Leboutet, H. (Compagnie Generale de Telegraphie Sans Fil, Corbeville (France). Division des Accelerateurs); Netter, F. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [1967]. 35p. (In French). (CONF-681208-8). Dep.

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France.

A detailed description is given of the Saclay electron linear accelerator. The base characteristics and the characteristics imposed on the beam are given. The results of the preliminary tests are reported. The principal sub-assemblies of the accelerator–the sections, high frequency power sources, stabilization and maintenance of the beam properties, and positron acceleration together with electron-positron converter–are described. Uses of the beam are indicated. (J.S.R.)

17015 (CERN-67-32) PRECISION MEASUREMENT OF WEAK MAGNETIC FIELDS. LONG-TERM STABILITY OF PERMANENT MAGNETS AND THE HALL EFFECT. Labeye, J. F.; Leroux, J.; Maurer, A. (European Organization for Nuclear Research, Geneva (Switzerland)). Nov. 1967. 69p. (In French). Dep.

In order to use the experimental 2-MeV storage ring at CERN, a gaussmeter with the Hall effect was made, capable of measuring nonhomogeneous magnetic fields in the range of 120 gauss with a resolution of the order of $\pm 5.10^{-6}$ and a long term stability of the order of $\pm 2.10^{-4}$. A very extended study of the behavior of Hall probes was carried out. It permits one to know the limits of stability and the process of stabilization in time. Different procedures have been used to verify or recalculate their calibration to better than $\pm 0,2\ \mu$ volts, without using a reference field (116 gauss). The result of this work should allow the use of the Hall effect with more precision than that obtained up to now for measuring fields 10 to 100 times greater. Some modifications of structure would be likely to improve measurements for superconducting magnets. (tr-auth)

17016 (CERN-68-43) STUDY OF TEMPORAL DISTRIBUTIONS IN THE BEAM OF THE SYNCHRO-CYCLOTRON. Levy, Ph. (European Organization for Nuclear Research, Geneva (Switzerland)). 1968. 35p. (In French). Dep.

A detailed study was made of the temporal structures of the internal and external beam of the CERN synchrocyclotron. The purpose was to understand the functioning of the slow extraction system and to improve the duty cycle of the machine. The methods used for the measurement of the exact temporal distribution of the events, the distribution separating two events, and duty cycles are described. The gross and fine structure of the beam was determined for short bursts and slow extraction. The implications of this study for the new design are discussed with respect to the extraction efficiency with the present SLE system, efficiency-duty cycle compromise with the present system, and adaptation of the principal program. (J.S.R.)

17017 (DNPL-R-2) PRELIMINARY DESIGN STUDY FOR A 15 TO 20-GeV ELECTRON SYNCHROTRON: NINA BOOSTER. (Daresbury Nuclear Physics Lab. (England)). 1968. 128p. Dep.

The preliminary design of a 15- to 20-GeV electron synchrotron using the 5-GeV Nina electron synchrotron as an injector is presented. A very brief account of the fields of physics open to such an accelerator and a short summary of the cost estimates are given. (W.H.K.)

17018 (JINR-P7-4289) PRODUCTION OF MULTIPLY CHARGED Xe IONS. Pasyuk, A. S.; Kutner, V. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1969. 5p. (In Russian). Dep.

Some characteristics of the multiply charged Xe ion source are given. The intensity of dodecacharged Xe ions is 120μA per pulse. (auth)

17019 (JINR-P9-4206) ON THE ELECTRICAL STRENGTH OF THE ACCELERATING RESONATOR OF HIGH-CURRENT MICROTRON. Matora, I. M.; Khar'yuzov, R. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1968. 11p. (In Russian). Dep.

The experimental data are given characterizing the effect of the residual gas pressure and operating conditions of the thermionic cathode on the lifetime of the high-current microtron resonator. The construction of the resonator is described in which unavoidable bombarding of the cathode cover with the ballast electrons occurs at the bottom of a special groove into which the powerful SHF field of the resonator does not penetrate. The electrical strength of the gap of such a resonator is considerably higher than of an ordinary one. (auth)

17020 (JINR-P9-4214) ON A MODE OF d AND He ACCELERATION IN THE JINR SYNCHROPHASOTRON UP TO 11 AND 22 GeV/c, RESPECTIVELY. Beznogikh, Yu. D.; Zinov'ev, L. P.; Kazanskii, G. S.; Mikhailov, A. I.; Moroz, V. I.; Pavlov, N. I. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1968. 26p. (In Russian). Dep.

Improvement of the existing accelerating systems of the JINR synchrophasotron is considered which allows one to accelerate, besides the protons, the deuterons and α-particles. The main idea of the regime suggested is to make the velocity of d- and α-particles, while passing from one accelerating system to the other, equal to half of that of protons. The acceleration of deuterons in a linear accelerator is performed at the second rate and in a proton synchrotron—in two stages, the first of which corresponds to the second rate. The first experiments performed proved the proper choice of the accelerating system had been made. (auth)

17021 (JINR-P9-4233) MAGNETIC FIELD DESIGN FOR THE 2-METER ISOCHRONOUS CYCLOTRON OF HEAVY IONS. Shelaev, I. A.; Kozlov, S. I.; Oganesyan, R. Ts.; Fefilova, S. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1968. 26p. (In Russian). Dep.

The results are presented of the magnetic field design for the 2-meter JINR isochronous cyclotron of heavy ions. The necessary field configuration is created by means of iron masses: ring shims and the change of the sector angle length. The magnetic field formed provides stable ion acceleration in a wide range of A/Z change. The field characteristics are given in graphs. (auth)

17022 (JINR-P13-4219) GAS-DISCHARGING ION SOURCE FOR ELECTROMAGNETIC MASS-SEPARATOR ON-LINE WITH THE HEAVY ION CYCLOTRON. PART II. Tarantin, N. I.; Kabachenko, A. P.; Dem'yanov, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1968. 18p. (In Russian). Dep.

The rapidity of operation of the previously described ion source for electromagnetic mass-separator on-line with the heavy ion cyclotron is measured. These results are obtained in the experiment with short-lived Ra and Rn isotopes, produced in the bombardment of lead with the accelerated ^{12}C ions. It is shown that the mean time from the moment of production and introduction of a nucleus into the ion source up to the moment, when the ion reaches the receiver of the electromagnetic mass-separator, is equal to 5 msec. The measurement results in the α-particle energy and the half-lives of some Ra and Rn isotopes, obtained with the help of this device, are also given. (auth)

17023 (MPS/SI/Int.DL-68-3) A SELECTION OF FORMULAE AND DATA USEFUL FOR THE DESIGN OF A.G. SYNCHROTRONS. Bovet, C.; Cohen, G. S.; Gouiran, R.; Gumowski, I.; Reich, K. H.; Saxon, W. M. (European Organization for Nuclear Research, Geneva (Switzerland)). Oct. 1, 1968. 47p. Dep.

Some basic relations including particle velocity, momentum, and energy; energy available in collision between two particles; magnetic and electric deflection; and some formulas for quantities related to synchrotrons are presented. Transverse phase space methods are outlined including matrix formulation of beam dynamics, single particle motion in a synchrotron, ellipse representation in transverse phase space, closed orbit, effects of various focusing perturbations on the frequency and amplitude of betatron oscillations, and space charge limit. Longitudinal phase space considerations include accelerating voltage, accelerating frequency, synchrotron oscillations, and debunching. Also, relations for magnets, ferrite-loaded rf accelerating cavities, and vacuum pressures required are given. (W.H.K.)

17024 (ORNL-4335, pp 102-7) SUPPORT FOR THE HIGH-VOLTAGE ACCELERATOR PROGRAM. (Oak Ridge National Lab., Tenn.).

Developments at the ORNL Van de Graaff accelerator are outlined including a saturable-reactor-controlled arc current supply, TV monitor for remote metering of the high-voltage terminal, a solid-state belt charge regulator, the use of silicon diode rectifiers in generating voltmeters, the use of sulfur hexafluoride insulating gas, a negative helium ion source, a polarized proton ion source, and the design of a scattering chamber. Also redesign of the pulley generator, improved vacuum pumping, and other design modifications of the 3-MeV Van de Graaff accelerator are summarized. (W.H.K.)

17025 (ORNL-tr-1897) CALCULATION OF THE SHIELDING AROUND THE TARGETS OF THE FRASCATI LINEAR ACCELERATOR. Pelliccioni, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from report LNF-66/14. 10p. Dep. CFSTI.

The shielding requirements for those points of the accelerator in which the energy of the beam can be in part or completely absorbed are determined. Calculations for neutrons produced in a tungsten target which can be inserted as a converter at the end of the high-current section are presented. (B.G.D.)

17026 (PPAD-654-E) OPERATIONAL MONITORING AT THE PRINCETON-PENNSYLVANIA ACCELERATOR. Schimmerling, W.; Awschalom, M. (Princeton-Pennsylvania Accelerator, Princeton, N. J.). Jan. 20, 1969. Contract AT(30-1)-2137. 49p. (CONF-690103-12). Dep. CFSTI.

From Health Physics Society Midyear Topical Symposium, Los Angeles, Calif.

The results of surveys for the main radiation areas are presented. Dose rates in the external beam hall have been 1-3 mrem/hr, almost entirely due to neutrons. The top of the external beam shielding has constituted a virtual radiation source. This made additional shielding necessary to protect a lunch room adjacent to the building. Remanent radioactivity results are presented. Finally, a device for establishing occupancy times automatically is described. The results of area surveillance are used to establish personnel doses wherever possible. A formula to establish occupancy times in mixed radiation fields is discussed. Picket dosimeters are shown to be more convenient and economical than thermoluminescent dosimeters for day-to-day monitoring. The only significant transferable activity ever found was due to a molybdenum-sesquisulphide-based lubricant. An extrapolation chamber has been used for surface dose measurements and results are presented. A network of fixed and mobile Bonner spheres is used for neutron dosimetry. Record keeping, use and maintenance for these are described. Deterioration of LiI (Eu) scintillators has been observed. The correlation of neutron film badge and Bonner sphere is described in different locations. The use of multisphere techniques in film badge calibration and fading compensation is presented. Tissue-equivalent ionization chambers are used for mixed field dosimetry. The eight inch chamber has been adapted to a cutie pie body to give an extremely useful portable instrument. ^{6}LiF and ^{7}LiF TLD pairs in the center of 2, 3, 5, 8, 10, 12, and 18 inch diameter spherical polyethylene moderators have been exposed to several gamma sources and a PuBe source, all of known intensity. Results of this calibration are discussed and conversion factors presented. (auth)

17027 EFFECTS OF PARTICLE SCATTERING WITHIN A BEAM OF POLARIZED ELECTRONS IN A STORAGE RING. Baier, V. N.; Khoze, V. A. At. Energ. (USSR), 25: 440-2(1968). (In Russian).

The lifetime (time for the number of particles to decrease by a factor of 2) of a beam of polarized particles is found with respect to internal scattering. It is assumed that all particles in the beam have the same energy, and that the vertical oscillations are much less than the radial oscillations of momentum in the beam. The lifetime is given for rectilinear and gaussian distributions of radial electron momenta with nonrelativistic and relativistic approximations. Small scattering angles and low velocities represent the main contributions to internal scattering. Hence the simpler formulas for rectilinear momentum distribution can be used. It is calculated that for an electron energy E = 700 MeV, where the characteristic time of radiation polarization is about 30 min, the relative contribution of polarization to the lifetime is about 6% with complete polarization of electrons; at E = 50 MeV the contribution is 20%. It is calculated that the time of depolarization is about 10^{6} seconds, while the time of radiation polarization is about 10^{3} sec under these same conditions. (TTT)

17028 DISTRIBUTION OF PARTICLES ACCORDING TO THE FREQUENCIES OF BETATRON OSCILLATIONS IN CIRCU-

LAR ACCELERATORS. Globenko, Yu. G.; Koshkarev, D. G. Prib. Tekh. Eksp., No. 6, 17-19(Nov.-Dec. 1968). (In Russian).

The distribution of particle bunches according to the frequency of betatron oscillations was determined from the amplitude and frequency characteristics of signals from the bunches, disturbed by pulsed field. The amplitude-phase characteristics of bunches obtained previously in the Inst. of Theoretical and Experimental Physics proton synchrotron were used for determining the distribution of accelerated particles according to the frequency of betatron oscillations. (tr-auth)

17029 MEASUREMENT OF THE FREQUENCY OF BETATRON OSCILLATIONS BY THE METHOD OF RESONANCE EXCITATIONS. Uvarov, V. A.; Senatorov, G. F. (Radiotechnical Inst., Moscow). Prib. Tekh. Eksp., No. 6, 20-3(Nov.-Dec. 1968). (In Russian).

A method is presented for determining the frequency of oscillations of the center-of-gravity of bunches and distribution of particles according to the frequency of betatron oscillations by investigating the amplitudes and phases of forced oscillations of the center-of-gravity of bunches from the frequency of the exciting signal. (tr-auth)

17030 ELECTROSTATIC ACCELERATOR WITH OVERCHARGING. Almazov, A. V.; Mironov, B. V.; Myntsov, F. F.; Roshal, G. Ya.; Serov, Yu. A. Prib. Tekh. Eksp., No. 6, 23-30(Nov.-Dec. 1968). (In Russian).

The main characteristics of an electrostatic accelerator with overcharging are described. The maximum energy of the accelerator is 10.5 MeV, the current on target is 10 μ Amps., and the stability of beam energy is about 0.1%. (tr-auth)

17031 SELF-TUNING THE FREQUENCY OF THE RESONANT SYSTEM OF A CYCLOTRON. Pirogov, N. V.; Kharitonenko, Yu. P.; Komov, A. I. (Tomsk Polytechnic Inst., USSR). Prib. Tekh. Eksp., No. 6, 30-2(Nov.-Dec. 1968). (In Russian).

A method was proposed for self-tuning the frequency of the resonant system of a cyclotron, not depending on the system of stabilization of the difference of the voltage amplitude of the dees. The method works in the range 5 to 12 MHz, with a range of stability of 32 kH_2 and the accuracy of stabilization of the voltage on the dee above 0.5%. (tr-auth)

17032 ONE-TURN QUADRUPOLE LENS. Vsevolozhskaya, T. A.; Danilov, L. L.; Silvestrov, G. I.; Sokolova, N. F. (Inst. of Nuclear Physics, Novosibirsk, USSR). Prib. Tekh. Eksp., No. 6, 32-5(Nov.-Dec. 1968). (In Russian).

The design characteristics, electron-optical properties, magnetic field characteristics, and the power supply of a one-turn quadrupole lens is described. (tr-auth)

17033 INTENSITY OF A STREAM OF MULTIPLY-REFLECTED ELECTRONS. Boyarshinov, L. M. Prib. Tekh. Eksp., No. 6, 35-6(Nov.-Dec. 1968). (In Russian).

On the basis of experimental data on repeated reflections of beta particles with a particular target material, an empirical formula for the relation of the intensity of streams of reflected electrons and the atomic number of the target material was derived for different number of reflections. (tr-auth)

17034 SOURCE OF POLARIZED NEGATIVE IONS OF HYDROGEN. Khirnyi, Yu. M.; Kochemasova, L. N. Prib. Tekh. Eksp., No. 6, 37-40(Nov.-Dec. 1968). (In Russian).

The design characteristics of a source of polarized negative ions were described. The process of ionization used is excitation of the $2S_{\frac{1}{2}}$ state of a cesium atom from proton interactions with cesium vapor at 0.5 keV, the luminescence of two lower sub-levels in a magnetic field of ~575 Oe, and subsequent selective overcharging of the excited neutral polarized particle bunch on argon. (tr-auth)

17035 VARIATION OF POLARIZATION OF ELECTRON BEAMS IN A HOMOGENEOUS MAGNETIC FIELD ON THE BASIS OF RECIPROCAL ACTION WITH THE ELECTROMAGNETIC RADIATION FIELD. Storck, Eckhard (Univ., Munich). Z. Naturforsch., 23a: 1914-28(Dec. 1968). (In German).

In order to get full information on the behavior of the polarization of electrons moving in a uniform magnetic field, the corresponding density matrix is studied in the Furry picture, and its rate of change caused by the interaction with the radiation field is calculated up to second order in the coupling constant e. In doing so one has to take account of matrix elements of higher, that is second order, because of their interference with forward scattering. The well-known precession of the polarization vector against the direction of momentum owing to the anomalous magnetic moment, superimposed by a turning towards the opposite direction of the magnetic field, the degree of polarization tending to a constant limiting value about 0.92 is obtained. This holds for an arbitrary initial polarization, in particular for originally unpolarized electrons. The polarization time decreases with increasing energy and magnetic field. In a modern storage ring this time is of the order of a few minutes and small compared to the storage time. (auth)

17036 TARGET POSITIONER FOR ACCELERATOR EXTERNAL BEAM. Stone, Kenneth F.; Jackson, Leslie T. (to United States Atomic Energy Commission). U. S. Patent 3,431,502. Mar. 4, 1969.

A target positioning apparatus of the flip-coil type is described for use in extracted beams from a charged particle accelerator, having a high speed coil drive which is independent of the accelerator magnetic field. A unique crank arm linkage from a drive motor to the target mount provides automatic damping of the target motion at the rest positions thereby preventing damage to a fragile target. (AEC)

17037 COAXIAL PULSE LINE FOR ACCELERATOR BEAM EXTRACTOR. Gagnon, William L.; Scalise, Dominic T.; Smith, Bob H. (to United States Atomic Energy Commission). U. S. Patent 3,433,977. Mar. 18, 1969.

A fast-pulse-forming line constructed of a group of coils serially and coaxially aligned within an electrically conductive inner cylinder with a large number of capacitors mounted on conductive annular discs in pairs of layers around the coils is described. The capacitors in each pair of layers have one set of terminals connected together to a disc that connects to the juncture of adjacent coils while the other capacitor terminals are connected together to a disc connected to the cylinder. An outer cylinder coaxially encloses the inner cylinder with resistors mounted and connected between the cylinders. (AEC)

17038 PROJECT OMEGA. CERN Cour., 9: 31-4(Feb. 1969).

A description of the project for a large magnet spark chamber assembly designed to serve as a major instrument for electronics experiments at CERN in the 1970's. The assembly is part of the second stage of the improvement program at the 28-GeV proton synchrotron. (B.G.D.)

17039 GAS CELL WITH MYLAR WINDOW. Chambon, B.; Drain, D.; Meynadier, C. (Institut d'Etudes Nucleaires, Algiers). Nucl. Instrum. Methods, 68: 167-8(Feb. 1, 1969). (In French).

A description is given of a Mylar window gas cell, designed for the study of nuclear reactions. (auth)

17040 ON THE REGENERATIVE BEAM EXTRACTION SYSTEM FOR THE BUENOS AIRES 180 cm SYNCHROCYCLOTRON. Mayo, S.; Sametband, M. J. (Comision Nacional de Energia Atomica, Buenos Aires). Nucl. Instrum. Methods, 68: 169-70 (Feb. 1, 1969).

A brief review of our recent work on this subject is presented in connection with a letter by Slobodrian (Nucl. Instr. & Meth 63: 355 (1968)). (auth)

17041 IMPROVED QUANTUM TREATMENT OF ROUND MAGNETIC ANALYZERS. Bosi, G. (Univ. of Moncton, Can.). Nucl. Instrum. Methods, 68: 171-2(Feb. 1, 1969).

Some failures in a recent attempt (Nucl. Instr. & Meth. 64: 297 (1968)) to describe the quantum behavior of an ideal round magnet are underlined and corrected. The theory applies to small deflections: this assumption simplifies most calculations involving higher transcendental functions. The actions on an infinitely wide beam and a diverging one are fully investigated. (auth)

17042 SUB-NANOSECOND BURSTS FROM AN AVF CYCLOTRON. Rethmeier, J.; Nijenhuis, J. G.; Langkau, R. (Vrije Univ., Amsterdam). Nucl. Instrum. Methods, 68: 135-7(Feb. 1, 1969).

Time structure in the cyclotron beam was studied with time-of-flight technique. It can be controlled with the correction coils, and the burst width may be reduced to 0.6 ns (10 MHz, 10.5 MeV d) with a 90% loss of current. (auth)

17043 SIMPLE, NONDESTRUCTIVE PROFILE MONITOR FOR EXTERNAL PROTON BEAMS. Hornstra, F. Jr.; Simanton, J. R. (Argonne National Lab., Ill.). Nucl. Instrum. Methods, 68: 138-40(Feb. 1, 1969).

Wire planes operating as ionization collectors with air as an ionizing medium have been used as nondestructive profile monitors in the external proton beam of the Zero Gradient Synchrotron. Results are in agreement with movable scatter target, scintillation telescope measuring techniques but are obtained with greater simplicity, versatility, and without associated background problems. The system is amenable to automatic scanning such that a complete beam profile may be obtained within a few milliseconds. (auth)

17044 SPECTRAL DENSITY OF THE CYCLOTRON BEAM CURRENT AND ACCIDENTAL COINCIDENCES IN NUCLEAR

ANGULAR CORRELATION MEASUREMENTS ON THE CYCLOTRON. Galkin, E. A.; Kosinov, G. A.; Lagutin, I. G.; Nemets, O. F.; Usik, V. A. (Inst. of Physics, Kiev). Nucl. Instrum. Methods, 68: 103-8(Feb. 1, 1969).

The spectral density of the cyclotron external beam for frequencies ranging from 0 to 11 MHz is measured. It is shown that under certain conditions the beam current dispersion may be reduced to the magnitude near zero. For several particular cases, a calculation is made of a number of accidental coincidences arising in the time-oscillations of the accelerated ion beam intensity. (auth)

17045 SCATTERING CHAMBER FOR GASEOUS TARGETS. Jones, C. M.; Johnson, J. W.; Beckers, R. M. (Oak Ridge National Lab., Tenn.). Nucl. Instrum. Methods, 68: 77-87(Feb. 1, 1969).

A recently constructed charged particle gaseous target scattering chamber is described and some of its operating properties are discussed. (auth)

17046 ENERGY CALIBRATION OF TANDEM ACCELERATORS. Overley, J. C.; Parker, P. D.; Bromley, D. A. (Yale Univ., New Haven). Nucl. Instrum. Methods, 68: 61-9(Feb. 1, 1969).

The beam energy homogeneity, stability and reproducibility of a model MP tandem Van de Graaff accelerator have been investigated. The 90° analyzing magnet system was calibrated using a number of (p,n) thresholds whose proton energies are known absolutely in the range from 4 to 10 MeV. The linearity of the beam momentum analysis system was then checked for higher magnetic rigidities by observing the $^{2}H(^{16}O,n)^{17}F$ neutron threshold for several different ^{16}O ionic charge states. The magnet calibration constant, obtained from a least-squares analysis of the results of threshold measurements for several different reactions, was reapplied to the data to obtain a new set of self-consistent energies for the calibration reactions themselves. This procedure, which relies on the assumption that the data are all measures of the same calibration constant, results in smaller statistical errors for the calibration energies than those previously cited. Measurements were then extended using the linearity of the analysis system as established by the $^{2}H(^{16}O,n)^{17}F$ measurements to include the $^{12}C(p,n)^{12}N$, $^{24}Mg(p,n)^{24}Al$, $^{28}Si(p,n)^{28}P$, $^{32}S(p,n)^{32}Cl$, and $^{40}Ca(p,n)^{40}Sc$ neutron thresholds at energies of 19.658 ± 0.005 MeV, 15.286 ± 0.003 MeV, 15.669 ± 0.004 MeV, 13.899 ± 0.014 MeV, and 15.491 ± 0.003 MeV, respectively. With the exception of the $^{32}S(p,n)^{32}Cl$ reaction, for which there are target difficulties, these thresholds provide the first series of calibration points in the energy range from 10 to 20 MeV. (auth)

17047 GAS TARGET WITH BUILT-IN SLIT GEOMETRY FOR SCATTERING EXPERIMENTS WITH CHARGED PARTICLES. Morsch, H. P.; Becker, T.; Fitz, W. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Instrum. Methods, 68: 39-41 (Feb. 1, 1969).

A gas cell has been built with radial shielding strips and slits at fixed angles. The $1/\sin\theta$ dependence of the effective target volume is compensated by different slit widths. (auth)

17048 TUNING ERROR SENSITIVITY OF STABILIZED LINEAR ACCELERATOR TANKS WITH FULL CELL TERMINATIONS. Swain, G. R. (Los Alamos Scientific Lab., N. Mex.). Nucl. Instrum. Methods, 68: 1-8(Feb. 1, 1969).

A slightly lossy biperiodic multicoupled resonator model is used to analyze the sensitivity of the fields to tuning errors in a standing wave linac tank. Perturbations of the $\frac{1}{2}\pi$-mode are used to represent the field behavior of stabilized or near-stabilized linac structures. The effects of couplings to cells beyond the nearest neighbor and the effects of an error in the average coupling resonator frequency are shown. Tables of error effects are given. (auth)

17049 ELECTRON RING ACCELERATORS. Keefe, Denis (Univ. of California, Berkeley). Sci. J., 5: 71-6(Mar. 1969).

A new principle, which could lead to cheaper and highly energetic accelerators of protons and heavy ions, is being rapidly developed in the United States and the Soviet Union. Its novelty depends on using rings of electrons to sweep along, and thus accelerate, heavier ions. (auth) (UK)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 15862, 15863, 15929, 16121, 16142, 16871, 16892–16894, 16896, 17108, 17111, and 17141.

17050 (NP-17773) A SYSTEMATIC STUDY OF FAST NEUTRON ELASTIC SCATTERING IN THE ENERGY REGION 1.5 TO 8.1 MeV. Holmqvist, Bertil (Lund Univ. (Sweden)). 1968. 9p. Dep.

Thesis.

A summary is presented of 3 published papers [Ark. Fys., 33: 297-312(1966), 34: 481-93(1967), and 38: 403-65(1968)] on the following subject: angular distributions of neutrons elastically scattered by natural Cu in the energy region 1.5 to 4.6 MeV; a Monte Carlo program for calculation of neutron attenuation and multiple scattering corrections; and a systematic study of fast neutron elastic scattering in the energy region 1.5 to 8.1 MeV. (Sweden)

17051 DEEP PENETRATION OF NEUTRONS IN ATTENUATING MEDIA. Ozer, Odelli. New York, Columbia Univ., 1968. 135p.

Thesis.

Various calculational methods were used to investigate the phenomena of importance for the calculation of neutron penetration in attenuating media. A series of clean, idealized geometry, high-precision calculations were made for water, oxygen, lead, and a fictitious forward scattering medium. The a priori rigorous methods were found to agree when used consistently and with the same set of cross sections. The effects of various cross section shapes were investigated. Dips or windows in the cross section were found to have a much more profound effect on the penetrating neutron flux than resonance peaks. Integral quantities such as dose were found to be in many instances insensitive to the detailed treatment of resonances. The higher order anisotropies in the angular distribution of elastically scattered neutrons were found to have little effect on angle integrated quantities such as scalar flux or dose. These are expected to be widely applicable conclusions for neutron penetration and reactor shielding problems. (Disser. Abstr.)

17052 EXPLICIT FORMS FOR SCATTERING TRANSFORMATION MATRICES $T_{Ll'}^{m}$. Harris, D. R. (Bettis Atomic Power Lab., Pittsburgh). Nucl. Sci. Eng., 26: 559-62(Dec. 1966). (WAPD-T-1895).

It is shown that analytic integration may be used to obtain explicit forms for the scattering transformation matrices used in analyzing nuclear reactions and neutron transport problems. (J.W.R.)

17053 ON THE PHYSICAL CRITERIA FOR THE LIMITING CRITICAL FREQUENCY OF NEUTRON WAVES. Moore, M. N. (San Fernando Valley State Coll., Northridge, Calif.). Nucl. Sci. Eng., 35: 301(Feb. 1969).

It is agreed that the criteria used in a previous paper for the limiting critical frequency of neutron waves are incorrect. Other methods for estimating the limiting critical frequency are proposed. (J.W.R.)

17054 COMMENTS ON MOORE'S LETTER "ON THE PHYSICAL CRITERIA FOR THE LIMITING CRITICAL FREQUENCY OF NEUTRON WAVES". Ahmed, Feroz; Kothari, L. S. (Univ. of Delhi). Nucl. Sci. Eng., 35: 302(Feb. 1969).

It is shown that the bases for Moore's criterion for determining the critical frequency for neutron waves propagating in a crystalline medium are invalid and that his proposed alternative criterion is also questionable. (D.C.W.)

17055 NEUTRON SCATTERING FROM SHORT-RANGE-ORDERED PARAMAGNETS. Rao, L. Madhav; Dasannacharya, B. A.; Murthy, N. S. Satya; Iyengar, P. K. (Bhabha Atomic Research Centre, Trombay, India). Solid State Commun., 7: 123-6(Jan. 1969).

A gaussian approximation was used to explain inelastic scattering of neutrons from liquids in the case of short-range-ordered paramagnets. In particular, inelastic neutron scattering from paramagnetic MnO is discussed. (auth) (UK)

17056 THEORETICAL APPROACH TO PSEUDO-MODE NEUTRON WAVES IN A MODERATOR. Utsuro, Masahiko (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo), 6: 90-100(Feb. 1969).

An analysis is presented on neutron wave propagation in moderators in the frequency region above the limiting frequency for discrete eigenvalues, and the distribution of the modulated neutrons in the medium is described by integrals over the continua. When a discrete eigenvalue reaches the edge of a continuum, a singularity appears in the angular distribution of the waves and causes the discrete mode waves to disappear. Further pursuit of the root of the dispersion law making use of the analytic continuation in the angular integral locates the root on a branch of the complex eigenvalue planes that adjoins the principal branch. This root on the adjacent branch can in certain cases bring about a sharp resonance, i.e. a "pseudo-discrete wave eigenvalue" in the continuum. The conditions for the effective excitation of this kind of pseudo-mode wave were examined, which revealed that for this it is essential that the neutrons causing the limiting frequency have a weak coupling and that their injection be light. It was also demonstrated that the distance from source affects the pseudo-discrete eigenvalue. An application of this analysis to the case of graphite is also presented. (auth)

17057 TIME SPECTRA FROM SPHERES PULSED WITH 14-MeV NEUTRONS. Hansen, Luisa F.; Anderson, John D.; Goldberg, Eugene; Plechaty, Ernest F.; Stelts, Marion L.; Wong, Calvin (Univ. of California, Livermore). Nucl. Sci. Eng., 35: 227-39(Feb. 1969).

Neutrons emitted from pulsed spheres were measured as a function of time in order to stringently test input parameters and computational assumptions in neutron transport calculations. Using the sphere transmission technique in conjunction with the time-of-flight facilities at Livermore, measurements were made for 0.5, 1.3, and 3.0 mfp of carbon, and for 1.0 mfp of nitrogen, using a 15.3-MeV pulsed neutron beam. The measured neutron time spectra proved to be sensitive, not only to the magnitude of the elastic and inelastic neutron cross sections, but also to the shape of their angular distributions. The analysis of the data was done using the Livermore Monte Carlo Neutron Transport Program (SORS). To obtain agreement with the data, a revision of some of the cross sections and respective angular distributions was required, which resulted in a dramatic improvement in the quality of the fits to the measured time spectra. (auth)

17058 NEUTRONS AND MOLECULES. Janik, J. A. (Jagellonian Univ., Krakow). pp 577-601 of Theory of Condensed Matter. Vienna, International Atomic Energy Agency, 1968.

See STI/PUB-205.

A review is presented of neutron scattering by molecules of a gas and by molecular groups in solids and liquids. The theory for gaseous scattering of neutrons is stressed, while for liquids and solids, an attempt is made to understand the scattering in terms of molecular dynamics. The following specific cases are considered: Gases: CH_4 and NH_3. Solids: CH_3I, CH_2I_2, thiourea, hydronium nitrate ($H_3O \cdot NO_3$), NH_4Cl, and CH_4. Liquids: water and CH_4. (37 references) (D.L.C.)

17059 ATOMIC MOTIONS IN LIQUIDS AND NEUTRON SCATTERING. Singwi, K. S. (Argonne National Lab., Ill.). pp 603-38 of Theory of Condensed Matter. Vienna, International Atomic Energy Agency, 1968.

STI/PUB-205.

Inelastic neutron scattering has given us evidence of collective motions in many wavelength regions. A review is presented of recent theoretical developments since 1964. Correlation functions, sum rules, incoherent scattering, frequency spectrum, memory function, self-motion theory, coherent scattering, convolution approximation, and quasi-crystalline model are covered. Scattering in liquid He and zero sound in liquid ^{4}He I are considered. (25 references) (D.L.C.)

17060 INELASTIC SCATTERING OF THERMAL NEUTRONS BY LIQUID SODIUM AND LEAD. Desai, Rashmi C. (Univ. of Toronto); Yip, Sidney. Phys. Rev., 180: 299-307(Apr. 5, 1969).

The spectra of thermal neutrons inelastically scattered by liquid sodium and lead are analyzed in terms of the mean-square displacement of an atom, using a phenomenological prescription for relating coherent and incoherent scattering. There are no adjustable parameters in the absolute intensity calculations, and the results are generally satisfactory. The difference in the computed cross sections obtained with a model description of the mean-square displacement or with the results found by computer molecular-dynamics experiments is found to be quite small, a conclusion that is consistent with earlier calculations for argon. (auth)

17061 GENERATING FUNCTIONS FOR THE EXACT SOLUTION OF THE TRANSPORT EQUATION. II. TIME DEPENDENT

WITH ANISOTROPIC SCATTERING. Abu-Shumays, I. K.; Bareiss, E. H. (Argonne National Lab., Ill.). Contract Nonr 1866 (34). J. Math. Phys. (N. Y.), 9: 1993-2001(Dec. 1968).

Part I introduced in detail the general method of transforming integrodifferential transport equations to partial differential equations. The treatment there is restricted to isotropic transport in slab geometry. This part extends the method to time-dependent anisotropic transport for slab geometry. Generating functions are used as an analytic tool to define appropriate transformations whose inverses are known. The general solution of the transport equation considered is expressed in terms of expansion modes. The expansion coefficients are determined by a combination of Fourier transforms and orthogonality relations. Fourier transforms in the time variable are used instead of the usual Laplace transforms. The solutions of the initial-value problem and its analog with the role of space and time interchanged are given. (auth)

17062 MEASUREMENT OF INCOHERENT SCATTERING CROSS SECTIONS FOR LEAD AND BISMUTH WITH SLOW NEUTRONS. Scherm, Reinhard (Kernforschungsanlage, Juelich, Ger.). Nukleonik, 12: No. 1, 4-6(Dec. 1968). (In German).

A precise measurement of the spin- and isotopic incoherent scattering cross sections σ_{ink} of lead and bismuth was performed by determining the intensity of slow neutrons scattered by the helium-cooled sample into a large solid angle. The detectors were calibrated using a vanadium sheet as a reference sample. With this method, an accuracy of 5% can be obtained. Their sensitivity allows to measure scattering cross sections in the order of magnitude of 10^{-4} barns. (auth)

17063 SCATTERING OF SLOW NEUTRONS BY REAL GASES. I. QUASI-IDEAL APPROXIMATION AND TOTAL CROSS SECTION. Fulinski, A.; Zgierski, M. (Jagellonian Univ., Krakow). Acta Phys. Pol., 34: 867-73(Nov. 1968).

The influence of intermolecular interactions in gases on the scattering of neutrons is investigated in the so-called quasi-ideal approximation. In this approximation the shape of neutron spectrum is unchanged, but the scattering cross section per particle differs from that for an ideal gas by a factor ρ/ρ_0, the ratio of the actual density to the density calculated from the ideal gas equation of state. It is shown that the coherent scattering vanishes in this approximation. (auth)

17064 ANOMALOUS SLOWING DOWN OF NEUTRONS IN PARAFFIN WAX. Cox, A. J.; New, S. A. (Univ. of Arton, Birmingham, Eng.). Int. J. Appl. Radiat. Isotop., 20: 199-201 (Mar. 1969).

The spectrum of neutrons from a ^{241}Am/Be source moderated by commercial paraffin wax was examined using a mechanical velocity selector, and it was found that the spectrum of neutrons was not thermal but had a peak at a considerably lower energy. The spectrum of the fast neutrons moderated in water was found to be approximately thermal. (auth) (UK)

17065 DENSITY SCALING OF THE BOLTZMANN EQUATION AND ITS APPLICATION. Gozani, Tsahi; Stevens, C. A. (Gulf General Atomic Inc., San Diego, Calif.). J. Nucl. Energy, 22: 751-7(Dec. 1968).

A general treatment of density and macroscopic cross-section scaling in systems is presented. The advantages of the scaling procedure and its applications are demonstrated for a wide range of experiments in reactor physics and related areas. The use of the method in a number of applications allows the conduct of experiments which would not otherwise be feasible. (auth) (UK)

17066 NUCLEAR ORIENTATION EXPERIMENTS WITH LOW-ENERGY NEUTRONS. Postma, H. (Kamerlingh Onnes Laboratorium, Leiden. Reactor Centrum Nederland, Petten). Ned. Tijdschr. Natuurk., 34: 263-84(Sept.-Oct. 1968). (In Dutch).

Typical experiments with low-energy neutrons are described, with illustrations from work done at the Petten high-flux reactor. The characteristics of the reactor as a neutron source are discussed. The transmission of polarized neutrons by preparations with polarized nuclei is considered. Nuclear orientation experiments with capture gamma readiation are described. The fission of oriented nuclei is discussed. Each of these concepts is illustrated by studies done at Petten. (J.S.R.)

17067 THE SCATTERING OF SLOW NEUTRONS BY REAL GASES. II. FIRST NON-QUASI-IDEAL CORRECTION. Fulinski, A.; Zgierski, M. (Jagellonian Univ., Krakow). Acta Phys. Pol., 34: 1037-46(Dec. 1968).

First- and second-order corrections for the spectrum of scattered neutrons by real gases, resulting from intermolecular interactions are investigated. It is shown that the formula for the incoherent scattering function, which is exact within the quasi-ideal approximation, is satisfied to order λ^1, where λ—is the coupling constant. (auth)

17068 THE SCATTERING OF SLOW NEUTRONS BY REAL GASES. III. SCATTERING BY GASEOUS METHANE. Fulinski, A.; Zgierski, M. (Jagellonian Univ., Krakow). Acta Phys. Pol., 34: 1047-56(Dec. 1968).

The numerical calculations of the first-order non-quasi-ideal correction to the differential cross section for scattering of slow neutrons by gaseous methane are presented. To do this, a new suitable form of intermolecular potential is proposed. The second-order corrections are also estimated. It is shown that intermolecular interactions are able to explain the disagreement between Griffing theory and experimental data. (auth)

17069 DIFFRACTION OF THERMAL NEUTRONS BY A RULED GRATING. Kurz, H.; Rauch, H. (Oesterreichische Hochschule, Vienna). Z. Phys., 220: 419-26(1969). (In German).

The diffraction of thermal neutrons by a plane Ni-covered ruled grating was investigated at various angles of incidence. A 54 lines per mm grating was used in the reflection case. The diffraction pattern was observed on both sides of the beam reflected in zero order (total reflection). Measured and calculated intensities are compared. (auth)

Nuclear Properties and Reactions, A≤ 5

Refer also to abstract 17103.

17070 (ANL-7462) ENDF/B NEUTRON CROSS-SECTION DATA FOR NATURAL HELIUM (ENDF-125). Pennington, E. M. (Argonne National Lab., Ill.). Oct. 1968. Contract W-31-109-eng-38. 33p. Dep. CFSTI.

The compilation of neutron cross-section data for natural helium is described. The elastic scattering cross section, $\bar{\mu}_L$, ξ, γ, and elastic scattering Legendre coefficients are included for ^{4}He. Since ^{3}He has a natural abundance of merely 0.00013%, only its (n,p) cross section, which is large at low energies, is considered. A listing of the data in the ENDF/B format is presented, as are graphs of much of the data. (auth)

17071 THE PHOTOPRODUCTION AND SCATTERING OF PIONS FROM ^{3}H AND ^{3}He. Ananthanarayanan, K. (MATSCIENCE, Madras). Symp. Theor. Phys. Math., 6: 245-60 (1968).

It is shown that the effects of small admixtures of the $T = 3/2$ and S' states on the differential cross section for the photoproduction of pions from ^{3}He and ^{3}H are negligible. The forward-angle cross section for π^+ scattering by ^{3}He can be used to make the correct choice of the radial function. (J.W.R.)

17072 ANGLE AND ENERGY DEPENDENCE OF THE POLARIZATION OF NEUTRONS FROM THE REACTION ^{2}H(d,n)^{3}He. Roeding, P.; Schoelermann, H. (Univ., Hamburg). Nucl. Phys., A125: 585-92(1969). (In German).

The angular distribution of the polarization of neutrons from the reaction ^{2}H(d,n)^{3}He was determined at five energies from 0.5 MeV to 2.0 MeV by left-right symmetry induced by elastic scattering from ^{4}He. A high-pressure helium-xenon gas scintillation counter served as scatterer. The scattered neutrons were detected by a time-of-flight method. The measured polarization shows a maximum value of about 25% at an angle of 50° and an energy of 0.5 MeV. (auth)

17073 THREE-NUCLEON CALCULATIONS WITH THE HAMADA-JOHNSTON POTENTIAL. Delves, L. M. (Univ. of Sussex, Falmer Brighton, Eng.); Blatt, J. M.; Pask, C.; Davies, B. Phys. Lett., 28B: 472-5(Jan. 20, 1969).

The triton binding energy E_T and doublet scattering length ^2a were calculated for the Hamada-Johnston potential. The results obtained were $E_T = -6.7 \pm 0.7$ MeV; $^2a = 1.2 \pm 1.0$ fm. The D-state and S'-state probabilities in the triton were calculated to be 9% and 2% respectively. (auth)

Nuclear Properties and Reactions, 6≤A≤19

Refer also to abstracts 17103, 17107, 17132, and 17138.

17074 (N-68-33763) MEASUREMENT OF THE ^{10}B(n,α)^{7}Li, ^{7*}Li RELATIVE CROSS SECTIONS IN THE keV REGION. Bogart,

Donald; Nichols, Lowell L. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Sept. 1968. 25p. (NASA-TN-D-4783). CFSTI.

Relative cross sections for $^{10}B(n,\alpha)^7Li$, $^7*Li$ were obtained from measurements of the counting ratios of a $^{10}BF_3$ proportional counter and a precision long counter used to monitor relative neutron fluxes. Monoenergetic neutrons were produced by a Van de Graaff accelerator in the energy region from 30 to 800 keV. When the relative cross sections are normalized to a 1/v variation below 80 keV, the data lie above a 1/v line from 80 to 550 keV indicating departures of 15% at 140 keV and 20% at 220 keV. Recommended cross sections for $^{10}B(n,\alpha)^7Li$, $^7*Li$ up to 1 MeV are obtained from recently available measurements and the known levels in ^{11}B. (auth) (STAR)

17075 CROSS SECTION OF PHOTOABSORPTION ON ^{11}B NUCLEI. Kurdyumov, I. V.; Smirnov, Yu. F. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., 23: 104-6(July-Aug. 1968). (In Russian).

Dipole photoabsorption in ^{11}B was studied in the jj-coupling approximation. Six types of transitions were found in contrast to previous calculations for ^{14}C. The integral cross section for photoabsorption and the energy levels in ^{11}B in a diagonal approximation were determined. (R.V.J.)

17076 ISOSPIN-NONCONSERVING DECAYS IN MIRROR NUCLEI. Adelberger, E. G.; Cocke, C. L.; Davids, C. N.; McDonald, A. B. (California Inst. of Tech., Pasadena). Phys. Rev. Lett., 22: 352-6(Feb. 24, 1969).

Branching ratios for the isospin-nonconserving particle decays of the 15.1-MeV $T = 3/2$ states in ^{13}N and ^{13}C to the $(0.0,0^+)$ and $(4.44,2^+)$ states of ^{12}C were measured. By comparing ratios of reduced widths with the 0^+ and 2^+ states of ^{12}C for the mirror decays, it is shown that the form of the isospin impurity in the 15.1-MeV states depends on T_z. (auth)

17077 A HEAVY-ION REACTION LEADING TO MEMBERS OF AN ISOSPIN MULTIPLET: $^{14}N + {}^{12}C \rightarrow {}^{13}N + {}^{13}C$. Von Oertzen, W.; Jacmart, J. C.; Liu, M.; Pougheon, F.; Roynette, J. C.; Riou, M. (Institut de Physique Nucleaire, Orsay, France). Phys. Lett., 28B: 482-4(Jan. 20, 1969).

A heavy-ion reaction leading to two members of the same isospin multiplet in the exit channel was studied. The angular distribution is symmetric about 90°. This proves the "indentity" of mass 13 mirror nuclei, as seen from a nuclear reaction in which isospin is conserved. (auth)

17078 INVESTIGATION OF THE FIRST TWO EXCITED LEVELS OF ^6Li BY ELECTRON SCATTERING. Neuhausen, Reiner (Univ., Mainz). Z. Phys., 220: 456-65(1969). (In German).

Inelastic electron cross sections for ^6Li were measured using the facilities at a 300-MeV linear accelerator. The form factor for the C2 transition to the 2.184-MeV level is given in the region of momentum transfer $0.4\ fm^{-1} < q < 1.9\ fm^{-1}$. It was possible to determine the form factor for the 3.562-MeV M 1 transition up to $q = 1.2\ fm^{-1}$. (auth)

17079 ENERGY DEPENDENCE OF THE ISOSPIN-NONCONSERVING REACTIONS $^{12}C(d,\alpha)^{10}B(0^+,T = 1)$ AND $^{16}O(d,\alpha)^{14}N$ $(0^+,T = 1)$. Noble, J. V. (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Lett., 22: 473-6(Mar. 10, 1969).

The resonance-like excitation function and strong forward peaking of the isospin-nonconserving $^{12}C(d,\alpha)^{10}B(0^+,1)$ and $^{16}O(d,\alpha)^{14}N$ $(0^+,1)$ cross sections can be reconciled by an appropriate choice of reaction mechanism interpreted in the strong-absorption model. (auth)

17080 THE COULOMB EXCITATION OF ^{18}O, ^{41}K, ^{45}Sc, AND ^{51}V. Andreev, D. S.; Afonin, O. F.; Bondarev, V. K.; Grinberg, A. P.; Erokhina, K. I.; Lemberg, I. Kh. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1671-3(1968). (In Russian).

Coulomb excitation of high-energy levels of the light nuclei ^{18}O, ^{41}K, ^{45}Sc, and ^{51}V was investigated by observed direct γ spectra by means of a scintillation spectrometer with a 70 × 70 mm NaI(Tl) crystal. The targets were bombarded by accelerated ^{18}O, ^{20}Ne, and ^{22}Ne ions. Tabulated data are discussed. (R.V.J.)

17081 REDUCED CLUSTER WIDTHS FOR ^{14}N AND ^{15}N. Zhusupov, M. A.; Lkhagva, O.; Rotter, I. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1714-18(1968). (In Russian).

Spectroscopic factors were calculated for excited states of ^{16}N and ^{15}N nuclei with $(1p)^{-n-2}(2s-1d)^n$ and $(1p)^{-n-1}(2s-1d)^n$ configurations in relation to the ground states of finite nuclei with $(1p)^m$ configuration nucleons in the 1p, 2s, and 1d shells formed various clusters. The spectroscopic factors determine the relative probability of formation of levels of finite nuclei in reactions of the type $^{10}B(^6Li,d)^{14}N$ and $^{11}B(^6Li,d)^{15}N$. (R.V.J.)

17082 DIPOLE PHOTODISINTEGRATION OF ^7Li NUCLEI. el Samarai, S. Kh.; Smirnov, Yu. F.; Yur'ev, B. A. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1709-13(1968). (In Russian).

The results of detailed calculations for the dipole states of ^7Li nuclei show that the multiparticle shell model which takes into account residual nucleon-nucleon interactions describes correctly the basic properties of the giant resonance. It is also shown that in ^7Li, ^6Li, and ^9Be strong splitting of the dipole state takes place according to the Jung schemes, producing several dipole states which differ by their decay properties. The high-energy states have star-shaped decays, emitting several complex particles (t + t + p) and (^2H + t + n). (R.V.J.)

17083 STUDY OF THE $^{14}N(d,d)^{14}N$ AND $^{14}N(d,p)^{15}N$ ANGULAR DISTRIBUTIONS AND EXCITED STATES OF ^{15}N. Beaumevieille, H. (Institut d'Etudes Nucleaires, Algiers); Lambert, M.; Yaker, M.; Amokrane, A.; Nguyen Van Sen. Nucl. Phys., A125: 568-84(1969).

Absolute differential cross sections for the six proton groups p_0, p_3 and p_{4-7} from the $^{14}N(d,p)^{15}N$ reaction and for $^{14}N(d,d)$ elastic scattering were measured at 12 different energies from 1 to 3.2 MeV with a differentially pumped gas target. A DWBA analysis of these cross sections allows a determination of spectroscopic factors for the ground state and the excited states in ^{15}N at 6.33, 7.16, 7.31, 7.57 and 8.31 MeV. (auth)

Nuclear Properties and Reactions, $20 \leq A \leq 89$

Refer also to abstracts 17050, 17080, 17103, 17107, and 17132.

17084 (COO-1779-4) NUCLEAR CHEMISTRY. Annual Report, 1968. McHarris, Wm. C. (Michigan State Univ., East Lansing). Dec. 1, 1968. Contract AT(11-1)-1779. 71p. Dep. CFSTI.

The decays of ^{53}Fe, ^{62}Zn, ^{63}Zn, $^{145}g,^mGd$, ^{147}Gd, ^{149}Gd, ^{167}Yb, ^{200}Pb, ^{203}mPb, ^{205}Bi, and ^{252}Es were investigated. Information on the isomeric states and on states in daughter nuclei was obtained. A PDP-9 computer was put into operation as a multichannel analyzer. A coincidence system for two-dimensional γ-ray spectroscopy was developed, and programs for manipulation of the data were developed. Methods for separating Gd from Eu and Sm were developed, as was a fast target changer for studies of short-lived isotopes. Development of an on-line isotope separator for the cyclotron facility was begun. (D.C.W.)

17085 (UCRL-50504) SEARCH FOR DIRECT NEUTRON CAPTURE IN ^{63}Cu, ^{59}Co, AND ^{55}Mn USING A Ge(Li) DETECTOR. Auchampaugh, George F. (California Univ., Livermore. Lawrence Radiation Lab.). Nov. 15, 1968. 61p. Dep. CFSTI.

The direct mechanism in the neutron radiative capture reaction was studied by the direct-resonance interference technique in the isotopes ^{63}Cu, ^{59}Co, and ^{55}Mn. An 18 cc Ge(Li) detector was used to measure the intensity of 5 transitions in copper, 9 in cobalt, and 11 in manganese as a function of neutron energy. Good least square fits to some of these data were achieved if the following values of direct capture cross section at 1-eV neutron energy were included: ^{63}Cu, 2.7 ± 1.5 mb (7.914 MeV), 8.1 ± 7.6 mb (7.303 MeV); ^{59}Co, 5.5 ± 1.5 mb (7.495 MeV). In manganese no positive statement could be made about the magnitude of the direct capture cross section for the three transitions studied in detail, namely the 7.150 MeV, 7.047 MeV and 5.054 MeV transitions. All other transitions studied required no direct amplitude to fit the data. Five neutron resonances which occur in natural copper below 2 keV were assigned to the ^{63}Cu isotope. These resonances occur at 405, 650, 807, 998, and 1368 eV. The 2.211-MeV state in ^{56}Mn was assigned $J^\pi = 1^+$. (auth)

17086 ELASTIC SCATTERING OF ELECTRONS BY NICKEL AND TIN ISOTOPES. Khavastunov, V. M.; Afanas'ev, N. G.; Afanas'ev, V. D.; Kul'karov, I. S.; Omelaenko, A. S.; Savitskii, G. A.; Khomich, A. A.; Shevchenko, N. G. (Physico-Technical Inst., Kiev). JETP Lett. (USSR) (Engl. Transl.), 8: 259-62 (Oct. 20, 1968).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 8: 420-4(Oct. 20, 1968).

Differential cross sections and cross section ratios for the elastic scattering of 225-MeV electrons by ^{58}Ni, ^{60}Ni, ^{64}Ni, ^{112}Sn, and ^{118}Sn were measured. The data were analyzed within the framework of the high-energy approximation with a Fermi charge-density distribution. Nuclear charge distribution parameters were obtained. A distinct correlation between the change of the charge radius in the isotopes and the orbital angular momenta (or the filling of the neutron subshells) of the added neutrons was noted. (D.C.W.)

17087 ISOMERIC CROSS-SECTION RATIO FOR THE REACTION $^{51}V(\alpha,3n)^{52g,m}Mn$. Smend, F.; Weirauch, W. (Univ., Goettingen, Ger.). Z. Phys., 219: 467-74(1969). (In German).

The isomeric cross-section ratio was measured for the reaction $^{51}V(\alpha,3n)^{52g,m}Mn$ between 32 and 51 MeV. The experimental results were compared with statistical-model calculations. In these calculations two models for the gamma cascade were used: the simple dipole cascade model of Vandenbosch and Huizenga, and alternatively the model of Poenitz which includes quadrupole transitions. With the latter model agreement between theory and experiment could be achieved. (auth)

17088 INELASTIC ELECTRON SCATTERING ON ^{24}Mg UP TO 11.5 MeV EXCITATION ENERGY. Titze, Otto (Technische Hochschule, Darmstadt, Ger.). Z. Phys., 220: 66-85(1969). (In German).

From experiments at low momentum transfer ($E_0 < 59$ MeV, $104° < \Theta < 153°$) ground-state radiative widths for levels at 9.85, 9.97, 10.72 MeV (1^+), 1.37, 4.23, 7.36, 9.00, 9.30, 10.36, 10.94, 11.47 MeV (2^+), 7.60, and 8.38 MeV (3^-), and ground-state matrix elements for levels at 6.44 and 10.7 MeV (0^+), were determined. Transition radii are also given. (auth)

17089 MEASUREMENT OF THE STATIC QUADRUPOLE MOMENT OF THE FIRST EXCITED STATE IN ^{24}Mg. Haeusser, O. (Chalk River Nuclear Labs., Ontario); Hooton, B. W.; Pelte, D.; Alexander, T. K.; Evans, H. C. Phys. Rev. Lett., 22: 359-62 (Feb. 24, 1969).

The static quadrupole moment of the first excited $J^\pi = 2^+$ state in ^{24}Mg was measured to be $Q = -0.243 \pm 0.035$ b. The experimental technique developed for this measurement uses the reorientation effect in heavy ion Coulomb excitation and allows accurate determinations of static quadrupole moments to be made, particularly in light nuclei. (auth)

17090 LIFETIMES IN ^{33}P AND ^{31}P. Currie, W. M.; Earwaker, L. G.; Martin, J.; Sen Gupta, A. K. (Atomic Energy Research Establishment, Harwell, Eng.). Phys. Lett., 28B: 480-1(Jan. 20, 1969).

The mean lives of the first and second excited states of ^{33}P were measured with the Doppler shift attenuation method to be 0.79 ± 0.23 and 1.36 ± 0.17 ps, respectively. Check measurements on the corresponding levels in ^{31}P yielded 0.80 ± 0.08 and 0.38 ± 0.03 ps, respectively. (auth)

17091 ON THE THIRD FORBIDDEN β-DECAY OF ^{87}Rb. Sastry, K. S. R. (Univ. of Massachusetts, Amherst). Phys. Lett., 28B: 462-4(Jan. 20, 1969).

It is shown that the shape of the third-forbidden β decay of ^{87}Rb may be satisfactorily explained by the single-particle shell model and the conserved vector current theory of weak interactions. (auth)

17092 A COMMENT ON PROTON AND NEUTRON DISTRIBUTIONS IN ^{40}Ca. Thomas, G. K. (King's Coll., London). Phys. Lett., 28B: 446-7(Jan. 20, 1969).

The results of optical-model analyses of proton elastic scattering from ^{40}Ca at 30 and 40 MeV combined with proton distribution parameters indicate that the neutrons have a larger rms radius than the protons. The average geometrical parameters for the real central potential obtained by Fricke et al. predict a similar result for a large range of nuclei. (auth)

17093 NUCLEAR ENERGY LEVELS OF ^{51}V AND ^{59}Ni. Raj, R.; Rustgi, M. L.; Singh, R. P. (State Univ. of New York, Buffalo). Phys. Lett., 28B: 468-9(Jan. 20, 1969).

The reaction matrix elements of Kuo and Brown were tested by calculating the nuclear energy levels of ^{51}V and ^{59}Ni. Good agreement between calculated and experimental energies was obtained for ^{51}V. For ^{59}Ni, the agreement was unsatisfactory but showed a little bit of improvement over the previously published theoretical results. (auth)

17094 STUDY OF THE (d,p) REACTION ON ^{48}Ti AND ^{50}Ti NUCLEI. Grotowski, K.; Jasielska, A.; Panek, T.; Pellegrini, F.; Wiktor, S. (Jagellonian Univ., Krakow. Inst. of Nuclear Physics, Krakow). Acta Phys. Pol., 34: 939-52(Nov. 1968).

Proton spectra from $^{48}Ti(d,p)^{49}Ti$ and $^{50}Ti(d,p)^{51}Ti$ reactions at incident deuteron energy of 12.9 MeV were measured in a wide range of angles. Six proton groups leading to ground, 1.38, 1.72, 2.50, 3.26 and 3.80 MeV states of ^{49}Ti and two proton groups leading to ground and 1.16 MeV states of ^{51}Ti were taken for the analysis of angular distributions. The distorted-wave, zero-range Born approximation method was applied, and the l-values as well as spectroscopic factors corresponding to different transitions were obtained. Four different sets of parameters of the deuteron optical potential were used in the DWBA analysis, and their influence on the shape of angular distributions and the magnitude of spectroscopic factors was investigated. These potentials only which have the depth of the real potential not lower than about 100 MeV appeared to be acceptable. In measured angular distributions, noticeable effects due to different coupling of spin and orbital angular momentum of transferred neutron were observed. The differences in shapes of angular distributions caused by that effect were related to the polarization of protons scattered elastically on Ti nuclei. (auth)

17095 ON THE MULTIPOLARITY OF THE 0.645-MeV TRANSITION IN ^{52}V NUCLEI. Bogdanov, A. P.; Soroka, A. V.; Tadeush, V. N.; Firsov, E. I. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk, No. 2, 122-5(1968). (In Russian).

Gamma-gamma angular correlations for the 6.51–0.645 MeV and 0.645–0.125 MeV cascades in ^{52}V following thermal neutron capture by ^{51}V were measured. Under the assumption that the ground state of ^{52}V is 3^+, the analysis of the data indicates that the 0.645-MeV transition is essentially pure M1. However, if the ground state is assumed to be 2^+, an M1/E2 mixture with $\delta \approx 1$ is indicated. (D.C.W.)

17096 LEVEL WIDTHS IN THE COMPOUND NUCLEUS ^{32}S FROM THE REACTION $^{31}P(p,p_0)$. Hellstroem, J.; Dallimore, P. J. (Australian National Univ., Canberra). Nucl. Phys., A125: 684-94(1969).

The mean level width in the compound nucleus ^{32}S at an excitation energy of between 16.61 and 18.55 MeV was investigated by the reaction $^{31}P(p,p_0)$. Excitation functions were measured in 10 keV steps from 8.00 to 10.00 MeV and at 15 angles between 30 and 160° (lab). The excitation functions were analyzed by the Fourier analysis method, and there is evidence for a dependence of the mean level width on angle. The statistical model is unable to predict this angular dependence, although it does predict the observed energy dependence of the mean level width. (auth)

17097 ELASTIC AND INELASTIC SCATTERING OF FAST NEUTRONS FROM IRON, NICKEL, AND TUNGSTEN. Tsukada, Kineo; Tanaka, Shigeya; Tomita, Yoshiaki; Maruyama, Michio (Japan Atomic Energy Research Inst., Ibaraki). Nucl. Phys., A125: 641-53(1969).

Differential cross sections for elastic and inelastic scattering of neutrons from iron, nickel and tungsten were measured with a time-of-flight spectrometer. Angular distributions were taken at incident neutron energies of 1.37, 1.71, 2.01, 2.65 and 3.26 MeV for iron, 2.01, 2.65, and 3.26 MeV for nickel and 1.37 and 2.01 MeV for tungsten. Excitation functions were measured at a scattering angle of 90° in an energy range of 1.37 to 4.49 MeV for iron, 2.01 to 4.49 MeV for nickel and 0.694 to 2.24 MeV for tungsten in 200-keV steps. The measured cross sections were compared with the optical-model, Hauser-Feshbach and Moldauer calculations. Corrections for level width fluctuations and for resonance interference contributions were applied to both the elastic and inelastic scattering. Best-fit sets of the potential parameters were obtained. (auth)

17098 SINGLE-PARTICLE BEHAVIOR IN FAST NEUTRON (n,2n) REACTIONS. Chatterjee, Swapna; Chatterjee, Aparesh (Calcutta Univ. Saha Inst. of Nuclear Physics, Calcutta). Nucl. Phys., A125: 593-612(1969).

A recent survey of the fast neutron (n,2n) reaction cross sections at excitation energies of 3, 6, and 7 MeV reveal a few interesting overlapping trends. Plotted against neutron excess, a structureless gross trend is seen throughout the mass region, while the second trend corroborates with the limited observations of Csikai and Peto; the third trend is one showing features of single-particle behavior (shell effects). The gross trend was analyzed in terms of a Levkovskii type equation. Further, an attempt was made to understand all these three trends semi-quantitatively as a compound nuclear decay process where the available residual excitation of a suitably shifted Fermi gas is propertly treated; the observed single-particle behavior (shell closure minima and the two Csikai-Peto trends) was compared in detail with the description in terms of the modified Rosenzweig shift functions. It was found that the predicted behavior agrees reasonably well with all the observations reported here in the medium weight and heavy nuclei. (auth)

17099 DECAY OF ^{87}Kr. Bocquet, J. P.; Brissot, R.; Crancon, J.; Pinston, J. A.; Schussler, F.; Moussa, A. (Centre d'Etudes Nucleaires, Grenoble, France). Nucl. Phys., A125: 613-25 (1969). (In French).

The decay of ^{87}Kr (76 min) leading to ^{87}Rb excited states was studied from on-line electromagnetically isotope separated sources. The use of a lithium-drifted germanium detector, scintillation-coincidence, and multichannel magnetic beta-ray spectrometers (used for single spectra as well as for coincidence spectra) give evidence for a new 2962 keV level. The beta branching ratios and

maximum beta spectrum energy were also accurately evaluated. (auth)

17100 CORIOLIS-COUPLING CALCULATION OF LOW-LYING STATES IN As ISOTOPES. Imanishi, N.; Sakisaka, M.; Fukuzawa, F. (Kyoto Univ.). Nucl. Phys., A125: 626-36(1969).

The theoretical level spectra and electrical properties of arsenic isotopes are reported. They were obtained by considering a collective and an intrinsic degree of freedom, where the motion of an unpaired quasi-particle in Nilsson's deformed orbit is coupled by a Coriolis force with the rotational motion. The level energies are expressed by two parameters η and $\hbar^2/2I$, the deformation parameter and the moment of inertia, respectively. For ^{75}As, a least-squares fitting procedure was carried out and a satisfactory agreement obtained between the calculated and experimental spectra for odd-parity levels below 1 MeV excitation energy. Most B(E2) values calculated without introducing any effective charge agree with experimental data to within a factor of two. For ^{77}As, tentative theoretical level schemes are presented. (auth)

17101 INVESTIGATION OF THE NUCLEAR STRUCTURE OF ^{50}Sc THROUGH THE ^{48}Ca(^{3}He,p)^{50}Sc REACTION. Laget, J. M.; Vervier, J.; Bruge, G.; Loiseaux, J. M.; Valentin, L. (Centre d'Etudes Nucleaires, Saclay, France). Nucl. Phys., A125: 481-503(1969).

The nuclear structure of ^{50}Sc was investigated through the ^{48}Ca(^{3}He,p)^{50}Sc reaction using ^{3}He ions accelerated to 18.5 MeV in a cyclotron and semiconductor detectors. Data were obtained on the excitation energies and the spins and parities of a large number of levels in ^{50}Sc up to 6.62 MeV. The experimental data were compared with DWBA calculations using various wave functions obtained in the framework of the shell model with different degrees of sophistication as to the orbits considered. A reasonable agreement was obtained up to 3.5-MeV excitation energy in ^{50}Sc for the most complex wave functions. Above 3.5 MeV, the results indicate the existence of strong L = 2 transitions in the (^{3}He,p) reaction, which are not explained by current models, and also a new and previously unidentified collective mode of excitation in ^{50}Sc. (auth)

17102 STUDIES OF COULOMB EXCITATIONS OF ^{21}Ne AND ^{29}Si ABOVE BARRIER ENERGIES. Andreev, D. S.; Afonin, O. F.; Bondarev, V. K.; Grinberg, A. P.; Erokhina, K. I.; Lemberg, I. Kh. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1674-5(1968). (In Russian).

The second excited state of ^{21}Ne at 1.75 MeV was investigated in a coulomb excitation experiment using the scattering of 39.9-MeV ^{21}Ne ions together with two NaI(Tl) scintillation spectrometers. The third excited state of ^{29}Si at 2.43 MeV was studied using the scattering of 36.8-MeV ^{12}C ions. (R.V.J.)

Nuclear Properties and Reactions, A ≥ 90

Refer also to abstracts 15929, 16062, 16124, 17050, 17084, 17086, 17097, 17098, and 17182.

17103 (ANL-7481) PHYSICS DIVISION SUMMARY REPORT. Annual Review, April 1, 1967-March 31, 1968. (Argonne National Lab., Ill.). Contract W-31-109-Eng-38. 190p. Dep. CFSTI.

Research progress dealing with neutron reactions and scattering (particularly resonance and thermal capture), charged-particle reactions and scattering, nuclear models, nuclear theory, nuclear matter, nuclear energy levels, photoionization of gases and high-temperature vapors, hyperfine structure, hyperfine fields, the Moessbauer effect, ion channeling, and quantum mechanics is summarized. Developments in radiation detectors, Moessbauer apparatus and techniques, atomic-beam techniques, and techniques for preparation of monocrystalline metal foils and filaments are also outlined. (D.C.W.)

17104 (BNL-13251) NUCLEAR AND PHYSICAL PROPERTIES OF ^{252}Cf. Prince, A. (Brookhaven National Lab., Upton, N. Y.). [1968]. 111p. (CONF-681032-4). Dep. CFSTI.

From Symposium on Californium-252, American Nuclear Society, New York.

A review of the nuclear and physical properties of ^{252}Cf is presented on the basis of a survey of the available experimental data. Alpha and spontaneous fission properties are covered, as are neutron cross sections and the average number of prompt neutrons emitted in neutron-induced fission. 106 references. (D.C.W.)

17105 (JINR-D7-4205) SPONTANEOUS FISSION OF LEAD-SEARCH FOR VERY FAR TRANSURANIUM ELEMENTS. Flerov, G. N.; Perelygin, V. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1969. 8p. (In Russian). Dep.

Tracks of nuclear fission fragments in Pb and its compounds were recorded by means of dielectric track detectors. For the lead glass this effect corresponds to the seemed spontaneous fission half-life of Pb (2 to 3 × 10^{20} years). Various possible sources of the effect being observed are analyzed. The assumption of existence of a long-lived spontaneously fissioning transuranic nuclide may serve as one of possible interpretations of the activity being observed. (auth)

17106 (ORO-2972-86) ISOSPIN MIXING AND THE CHARGE EXCHANGE INTERACTION IN (d,p) REACTIONS ON $^{90\,91\,92}$Zr. Technical Report No. 4. Clarkson, R. G.; Coker, W. R.; Griffy, T. A.; Moore, C. F. (Texas Univ., Austin. Center for Nuclear Studies). Oct. 1968. Contract AT(40-1)-2972. 242p. Dep. CFSTI.

Angular distributions and excitation functions for (d,p) reactions on ^{90}Zr, ^{91}Zr, and ^{92}Zr were measured at deuteron energies of 4 to 11 MeV. Deuteron and proton elastic scattering angular distributions were also measured in order to obtain optical model parameters for the DWBA analysis of the (d,p) data. Spectroscopic factors were determined from the DWBA analysis, and l-value assignments were made or confirmed for a number of states. In addition, the effects of mixing of T = 1 states in the deuteron, arising from the Coulomb field of the nucleus, were calculated for (d,p) stripping reactions. A computer program was written to calculate this mixing, to second order in the Born approximation, using plane-wave stripping theory and the dipole approximation for the Coulomb field. The admixture calculated in these approximations was found to be appreciable for typical cases in medium-weight nuclei. The dependence of the mixing on the charge of the target nucleus was also analyzed; it was found that the T = 1 admixture decreased with increasing target charge. Experimentally, effects that are perhaps due to the charge exchange threshold were observed. (D.C.W.)

17107 (OU-LNS-68-1) ANNUAL REPORT [ON NUCLEAR STUDIES], JANUARY 1967-DECEMBER 1967. (Osaka Univ. (Japan). Lab. of Nuclear Studies). 43p. Dep.

The scattering of α particles by ^{27}Al, ^{40}Ar, ^{12}C, ^{24}Mg, ^{25}Mg, ^{26}Mg, and ^{16}O was investigated in order to study compound-nucleus states and states in target nuclei. Angular distributions were measured for (d,α) reactions on ^{40}Ar and ^{20}Ne. The internal conversion electron spectrum emitted in the decay of ^{106m}Ag was observed, as were conversion electron spectra resulting from α reactions with ^{197}Au. The nuclear magnetic moments of ^{12}B and ^{12}N were also determined, and the half-life for double β decay of ^{130}Te was measured. Excitation functions for (d,p) reactions on ^{63}Cu, ^{96}Ru, ^{102}Ru, and ^{104}Ru were measured. A current integrator was developed, and the cyclotron was equipped with a frequency stabilizer. Charge-sensitive preamplifiers were developed; and design studies were carried out for a 230-cm isochronous cyclotron, including scale-model studies. An on-line data processing system was installed, and double-focusing mass spectrometers were developed. A totally depleted Si surface-barrier dE/dx detector was fabricated, and fabrication of large-volume Ge(Li) detectors was undertaken. (D.C.W.)

17108 MULTILEVEL EFFECTS ON INFINITE DILUTION RESONANCE INTEGRALS. Pennington, E. M.; Sargis, D. A. (Argonne National Lab., Ill.). Nucl. Sci. Eng., 35: 297-8(Feb. 1969).

A comparison was made for ^{239}Pu of the effect of using either single-level or multilevel formulas in calculating infinite dilution capture and fission resonance integrals. Resonance parameters were generated according to the appropriate statistical distributions and were used in both the Reich-Moore multilevel and Breit-Wigner single-level formulas to calculate capture and fission cross sections. The capture and fission resonance integrals were then calculated by numerical integration. (D.C.W.)

17109 POPULATION OF GROUND-STATE ROTATIONAL LEVELS IN (α,2nγ) REACTIONS. Mills, S. J.; Rautenbach, W. L. (CSIR, Pretoria). Nucl. Phys., A124: 597-608(1969).

The relative intensities of ground-state rotational transitions in the nuclei ^{154}Gd, ^{164}Er, ^{178}W, ^{180}W, ^{182}W, and ^{190}Pt produced in (α,2nγ) reactions at energies between 19.2 MeV and 31.7 MeV, were measured with a Ge(Li) detector. The results are compared with calculations based on the statistical description of compound nuclear reactions. It is shown that this model is not able to explain these experimental results as satisfactorily as in the case of isomeric cross-section ratios. (auth)

17110 NEUTRON PARTICLE-HOLE STATES OBSERVED BY INELASTIC PROTON SCATTERING FROM ^{136}Xe. Moore, P. A. (Univ. of Texas, Austin); Riley, P. J.; Jones, C. M.; Mancusi,

M. D.; Foster, J. L. Jr. Phys. Rev. Lett., 22: 356-9(Feb. 24, 1969).

Neutron particle-hole states were observed in the decay of isobaric analog resonances formed in the reaction ^{136}Xe plus proton. Analysis of the on-resonance inelastic data yielded inelastic proton partial widths, spectroscopic factors, spins, and parities of several of the observed particle-hole states. (auth)

17111 DELAYED NEUTRON EMISSION PROBABILITIES OF Rb AND Cs PRECURSORS. THE HALF-LIFE OF ^{97}Rb. Amarel, I.; Gauvin, H.; Johnson, A. (Institut de Physique Nucleaire, Orsay, France). J. Inorg. Nucl. Chem., 31: 577-84 (Mar. 1969).

By on-line mass spectrometry on the 150-MeV external proton beam of the Orsay synchrocyclotron the isotopes ^{97}Rb and $^{142-143-144}$Cs were identified as delayed neutron precursors. The half-life of ^{97}Rb (0.135 sec) was measured, as well as the absolute probabilities of delayed neutron emission from the precursors $^{93-94-95-96}$Rb and $^{143-144}$Cs. (auth) (UK)

17112 EFFECTIVE PROTON–NEUTRON INTERACTIONS IN THE NUCLEI OF $90 \leq A \leq 140$. Yagi, K. (Osaka Univ.). Phys. Lett., 28B: 455-7(Jan. 20, 1969).

The Z dependence of neutron-single hole (particle) energies in ^{139}Ce, ^{117}Sn, and ^{91}Zr is explained on the basis of effective p-n interactions. A tensor force with the radial dependence of r^2 type is effective. (auth)

17113 ALPHA DECAY HALF-LIVES OF ^{242}Pu AND ^{244}Pu. Bemis, C. E. Jr.; Halperin, J.; Eby, R. (Oak Ridge National Lab., Tenn.). J. Inorg. Nucl. Chem., 31: 599-604(Mar. 1969).

The partial alpha decay half-lives of ^{242}Pu and ^{244}Pu were determined by a relative specific activity technique using ^{239}Pu as the reference. The measured alpha decay half-lives were $3.869 \pm 0.016 \times 10^5$ yr and $8.28 \pm 0.10 \times 10^7$ yr, respectively. Alpha particle energies (and intensities) to the ground state and to the first excited state in ^{240}U from the decay of ^{244}Pu were measured as 4.587 ± 0.001 MeV (80.6 per cent) and 4.544 ± 0.001 Mev (19.4 per cent), respectively. The alpha decay Q-value for ^{244}Pu was determined to be 4.701 ± 0.001 Mev. (auth) (UK)

17114 CALCULATIONS OF SINGLE-PARTICLE STATES OF DEFORMED RARE EARTH NUCLEIC IN APPROXIMATION OF FINITE POTENTIAL WITH DIFFUSE EDGE. Gareev, F. A.; Ivanova, S. P.; Kalinkin, B. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1690-1702 (1968). (In Russian).

Calculations of single-particle states of deformed rare earth nuclei in the approximation of a finite potential with a diffuse edge show that the single-particle basis constructed for the realistic potential leads to a detailed analysis of deformed nuclei because it was developed taking into account a series of physical factors which were not considered previously. (R.V.J.)

17115 BRANCHING RATIO OF ^{133}Sb DECAY TO ^{133}Te ISOMERS. Parsa, Bahman; Gordon, G. E.; Wenzel, Allen (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-905. J. Inorg. Nucl. Chem., 31: 585-90(Mar. 1969).

Antimony samples were quickly separated from fission products. After a short decay period, Te daughters were isolated, and their γ rays observed with a Ge(Li) detector. The fractions of decay of 2.7-min ^{133}Sb to 12.5-min ^{133g}Te and 55-min ^{133m}Te were found to be 0.58 ± 0.06 and 0.42 ± 0.06, respectively. The cumulative yield of ^{133}Sb in thermal neutron fission of ^{235}U was measured as 1.7 ± 0.4 per cent. An upper limit of 0.29 per cent was determined for the yield of an 11 sec ^{134}Sb in thermal neutron fission of ^{235}U. (auth) (UK)

17116 INDEPENDENT YIELDS OF ^{124}Sb, ^{126}Sb, AND ^{136}Cs IN 14.8-MeV NEUTRON-INDUCED FISSION OF THORIUM AND URANIUM. Rao, A. S.; Rao, M. N.; Kuroda, P. K. (Univ. of Arkansas, Fayetteville). J. Inorg. Nucl. Chem., 31: 591-7(Mar. 1969).

Independent yields of 60-day ^{124}Sb, 12.5-day ^{126}Sb and 12.9-day ^{136}Cs in 14.8-MeV neutron-induced fission of ^{232}Th and ^{238}U were measured as 0.068 ± 0.017, 0.017 ± 0.004, and 0.098 ± 0.016 percent, respectively, for thorium fission, and 0.024 ± 0.005, 0.010 ± 0.004, and 0.049 ± 0.008 percent, respectively, for uranium fission. Measured independent yields for fission products in the asymmetric fission region of the mass-yield curves agreed well with the calculated values based on the equal charge displacement rule. Data for the fission products in the symmetric fission region of the mass-yield curves showed better agreements with the calculated values based on the constant charge ratio hypothesis. (auth) (UK)

17117 COULOMB EXCITATION OF ^{105}Pd. Gal'perin, L. N.; Grinberg, A. P.; Il'yasov, A. Z.; Lemberg, I. Kh.; Firsanov, G. A.; Chugunov, I. N. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1676-9 (1968). (In Russian).

The Coulomb excitation of ^{105}Pd was investigated using a Ge(Li) spectrometer with a resolution of 5.8 keV for the ^{137}Cs 661-keV γ ray. A ^{14}N beam at 46.1 MeV was used together with a metallic target enriched to 86.8% ^{105}Pd. E2 transition probabilities were determined, and a level scheme for ^{105}Pd was proposed. (D.C.W.)

17118 STUDIES OF ^{156}Gd LEVELS EXCITED DURING THERMAL NEUTRON CAPTURE BY e-γ COINCIDENCE METHOD. Govor, L. I.; Ivanov, V. A. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1719-25(1968). (In Russian).

The levels excited in ^{156}Gd and ^{150}Sm by thermal neutron capture in ^{155}Gd and ^{149}Sm were investigated by measuring conversion electron–γ coincidence spectra using a magnetic $\sqrt{2\pi}$ spectrometer together with an NaI(Tl) γ spectrometer. (R.V.J.)

17119 HEAVY ISOTOPE OF PROTACTINIUM. Trautmann, N.; Denig, R.; Kaffrell, N.; Herrmann, G. (Univ., Mainz). Z. Naturforsch., 23a: 2127-30(Dec. 1968).

A new isotope of Pa, 2.3-min ^{238}Pa, was identified in bombardments of ^{238}U with 14-MeV neutrons; and 9.1-min ^{237}Pa, 9.1-min ^{236}Pa, and 24-min ^{235}Pa, which were produced by irradiation of U isotopes with 14-MeV neutrons and 100-MeV bremsstrahlung, were also studied. β and γ energies and intensities were determined for all four isotopes, as were the half-lives. Information on the energy levels of ^{238}U was obtained from the data for ^{238}Pa. (D.C.W.)

17120 INTERNAL CONVERSION STUDIES OF THE 114 keV TRANSITION IN ^{175}Lu. Nilsson, Oe.; Toernkvist, S.; Malmsten, G.; Thun, J. E.; Hoegberg, S.; Baade, N. (Univ. of Uppsala). Z. Phys., 221: 106-12(1969).

Measurements of the conversion line intensities, the directional correlation, and the conversion probability for the 114-keV M1 + E2 transition in ^{175}Lu are reported. The E2 admixture, determined from relative K and L intensities, is 19.2 ± 0.2%. The theoretical L_I internal conversion coefficient is found to be about 8% too low relative to the K, L_{II}, and L_{III} conversion coefficients. (auth)

17121 NUCLEAR STATES OF ^{98}Zr. Blair, A. G.; Beery, J. G.; Flynn, E. R. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Lett., 22: 470-3(Mar. 10, 1969).

By means of the reaction ^{96}Z(t,p), the first reported production of excited states of ^{98}Zr was achieved. Comparison of the experimental proton angular distributions with the predictions of a distorted-wave calculation has yielded spin and parity assignments for many of the states. Possible identification of neutron configurations with some of the states is discussed. (auth)

17122 SPINS AND ORBITAL ANGULAR MOMENTUM CONFIGURATIONS OF LEVELS IN ^{90}Y. Bernstein, E. M. (Univ. of Texas, Austin); Michelman, L. S.; Bonner, T. I.; Adams, J. L.; Chen, Cary. Phys. Rev. Lett., 22: 476-9(Mar. 10, 1969).

Polarization and differential cross-section measurements were made for ^{89}Y(p,p)^{89}Y in the isobaric analog regions of the 2^- and 1^- states at 2.48 and 2.63 MeV in ^{90}Y. An optical-model-plus-resonance analysis of the data indicates that these states can be described by a $d_{\frac{5}{2}}$ state coupled to the $\frac{1}{2}^-$ target spin. The admixture of $d_{\frac{3}{2}}$ and $s_{\frac{1}{2}}$ configurations in the 2^- and 1^- states, respectively, is found to be small. The spin sequence 2^-, 1^- with the higher spin lower in energy is strongly favored. (auth)

17123 HIGH-ENERGY K-CONVERSION COEFFICIENTS FOR ^{114}Cd AND ^{150}Sm. Carroll, C. O. (Nuclear-Chicago Corp., Des Plaines, Ill.); O'Connell, R. F. Nucl. Phys., A125: 637-40(1969).

High-energy K-conversion coefficients were calculated using relativistic Hartree-Fock-Slater wave functions for ^{114}Cd and ^{150}Sm, multipolarities E1, E2 and M1 and for gamma-ray transition energies from 1 MeV to 17 MeV (existing tabulations do not exceed 2.5 MeV). All the available data for the elements in this energy region were compared, and the serious disagreements were examined. It was concluded that the present results are correct, and the present theory is valid in this energy domain. (auth)

17124 SHELL-MODEL CALCULATIONS ON DEFORMED NUCLEI. Lamm, Inger-Lena (Lund Inst. of Tech., Sweden). Nucl. Phys., A125: 504-30(1969).

A slightly modified deformed nuclear single-particle potential was investigated in detail in the rare earth and actinide regions. Its parameters were determined so as to reproduce optimally the observed single-particle level order in deformed nuclei. The most important single-particle matrix elements connected with decoupling factors and magnetic moments were calculated, and in these cases, a Y_1^1 term in the potential was included. Some

collective properties such as quadrupole moments were calculated. (auth)

17125 EXPERIMENTAL STUDY OF THE (d,p) REACTIONS AT 12 MeV ON THREE EVEN YTTERBIUM ISOTOPES. Gastebois, J.; Fernandez, B.; Laget, J. M. (Centre d'Etudes Nucleaires, Saclay, France). Nucl. Phys., A125: 531-44(1969).

Three odd-neutron ytterbium isotopes (A = 171, 173 and 175) were studied by means of (d,p) reactions at 12 MeV on even isotopes (A = 170, 172 and 174). A DWBA analysis was carried out, and it appears that difficulties due to inelastic scattering effects in the deuteron channel could be avoided by performing coupled-channel calculations. Nevertheless, a comparison between the three final nuclei was possible. (auth)

17126 THE LOW-LYING EXCITED STATES OF ^{103}Rh. Black, J. L.; Caelli, W. J.; Watson, R. B. (Australian National Univ., Canberra). Nucl. Phys., A125: 545-67(1969).

The decay scheme for the nucleus ^{103}Rh was studied and revised. The excited states were populated either through the Coulomb excitation of ^{103}Rh or through the nuclear reaction ^{103}Rh(p,p')^{103*}Rh. The B(E2) values were extracted from the Coulomb excitation data. The proposed level scheme is discussed in terms of a vibrational model for ^{103}Rh, in which it is assumed that most of the negative-parity states arise from the coupling of a $2p_{\frac{1}{2}}$ proton to the vibrational states of the neighboring doubly even core nucleus. (auth)

17127 MEASUREMENT OF α_K FOR THE 91.5 keV E2 TRANSITION IN ^{164}Er. Boneau, D.; Hatch, E. N. (Ames Lab., Iowa). Nucl. Phys., A118: 238-40(1968). (IS-1800).

The K-shell internal conversion coefficient, α_K, for the 91.5 keV $2^+ \rightarrow 0^+$ transition in the decay of ^{164}Ho to ^{164}Er was measured by the K x-ray/γ ratio method with scintillation crystals. Photons seen by the NaI detector were required to be in coincidence with continuous beta rays in order to eliminate effects of the competing electron capture decay of ^{164}Ho to ^{164}Dy. The experimental conversion coefficient $\alpha_K = 1.31 \pm 0.11$ agrees with the presently available theoretical values for an E2 transition. (auth)

Nuclear Theory

Refer also to abstracts 16908, 16960, 16970, 17052, 17079, 17100, 17103, 17112, and 17124.

17128 (MIT-2098-518) NUCLEAR FORCES AND HARTREE-FOCK CALCULATIONS. Kerman, A. K. (Massachusetts Inst. of Tech., Cambridge). Jan. 1969. Contract AT(30-1)-2098. 98p. Dep. CFSTI.

A review of some research dealing with soft-core potentials for the nuclear force and perturbation theory based on the Hartree-Fock approximation is presented. Nuclear forces, infinite nuclear matter, finite nuclei, and Hartree-Fock calculations are discussed. (D.C.W.)

17129 THREE-PARTICLE STRIPPING REACTIONS. Dumitrescu, O.; Kuemmel, H.; Saendulescu, A. (Max-Planck-Institut fuer Chemie, Mainz). Z. Phys., 220: 45-65(1969).

The formalism for the coupled-channel analysis of stripping reactions of complex nuclear projectiles by nuclei is presented. The general adiabatic approximation is developed. The indirect transitions that are considered are those which arise via intermediate rotational excitations of the target and product nuclei, i.e., the adiabatic approximation for rotational bands is used. At the same time the generalized DWBA procedure is considered for the intrinsic states. Also the antisymmetrization problem is solved. A new method for the calculation of the matrix elements of the (α,n) stripping reaction with finite range effective forces is developed. The method is based on an expansion of the radial functions which describe the relative motion in terms of harmonic oscillator wave functions multiplied by a Gauss one. Effective forces of Gauss type are assumed between the outgoing neutron and each captured nucleon. (auth)

17130 DISTORTED WAVE THEORY OF KNOCKOUT REACTIONS. Calboreanu, A. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys., 13: 749-66(1968).

A finite-range distorted-wave theory for knock-out reactions is formulated for (p,n) and (n,p) reactions under the assumption that the initial and final nuclei are described by the shell model and the uppermost shell contains N nucleons. Formulas for angular distributions, polarization, and particle-γ angular correlations are obtained. (auth)

17131 ON THE USE OF A NONCENTRAL VELOCITY-DEPENDENT POTENTIAL FOR THE INTERPRETATION OF THE NUCLEON-NUCLEON SCATTERING DATA. Appel, Kurt (Technische Univ., Hanover). Z. Phys., 219: 447-61(1969).

A phenomenological nucleon-nucleon potential containing a noncentral velocity-dependent term of the form $(\sigma_1 \cdot p)(\sigma_2 \cdot p)$ was used to fit the solutions YLAM and YLAN 3 M of the phase-shift analysis of Breit et al., and Hull et al., for proton-proton and neutron-proton scattering, respectively. The potential contains altogether 20 parameters. The fit was carried through in the range from 10- to 30-MeV laboratory energy. While the results for the p-p phase parameters are useful only in some cases, the results for the n-p phase parameters are in general quite satisfactory. (auth)

17132 β-DECAY AND μ-CAPTURE COUPLING CONSTANTS. Nair, S. C. K. (MATSCIENCE, Madras). Symp. Theor. Phys. Math., 6: 125-9(1968).

Some calculations for weak interaction coupling constants relevant to β decay and μ capture processes are reported. The recent literature concerning these coupling constants is briefly reviewed. (J.W.R.)

17133 SPIN POLARIZATION EFFECTS IN ODD-MASS DEFORMED NUCLEI. Kuliev, A. A.; Pyatov, N. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Lett., 28B: 443-5 (Jan. 20, 1969).

Within the framework of the Tamm-Dancoff method, the spin polarization effects are interpreted as caused by the "scattering" of the odd nucleon on the 1^+(K = 0 or 1) excitations of the even core. On this assumption the values of the effective factors g_K^Z and g_K^S are connected with the "scattering" process on the 1^+ 0 and 1^+ 1 excitations, respectively. It is pointed out that it is necessary to take the latter process into account in calculating the decoupling parameter for the $K = \frac{1}{2}$ spin up states. The numerical calculation is performed for the $\frac{1}{2}^-$ [510] Nilsson state. (auth)

17134 STABILITY OF SUPERHEAVY NUCLEI AND THEIR POSSIBLE OCCURRENCE IN NATURE. Nilsson, S. G.; Thompson, S. G.; Tsang, C. F. (Univ. of California, Berkeley). Phys. Lett., 28B: 458-61(Jan. 20, 1969).

Alpha and spontaneous fission half-lives were estimated theoretically in the region of beta-stable nuclei with $Z \approx 114$, $N \approx 184$. The possible existence of an island of stability is strongly supported. A preliminary search for surviving superheavy elements in nature gave negative results. (auth)

17135 PHENOMENOLOGICAL LIMIT OF THE SEMIMICROSCOPIC DESCRIPTION. Sips, L. (Inst. Ruder Boskovic, Zagreb. CEN, Saclay, France). Phys. Lett., 28B: 448-9(Jan. 20, 1969).

A simple phenomenological model of coupled proton and neutron vibrations is considered. Cubic terms in the potential are taken and the results compared with recent findings. (auth)

17136 EFFECTIVE CHARGES FOR ELECTRIC MULTIPOLE TRANSITIONS. I. FIRST ORDER PERTURBATION THEORY. Siegel, S.; Zamick, L. (Rutgers - The State Univ., New Brunswick, N. J.). Phys. Lett., 28B: 450-2(Jan. 20, 1969).

The effective charge for electromagnetic transitions in nuclei is shown to be dependent on the multipolarity of the transitions, being smaller for E3 transitions than for E2 transitions. The effective charge is also dependent; it usually increases as the orbital angular momentum of the polarizing nucleon increases. (auth)

17137 EFFECTIVE CHARGES FOR ELECTRIC MULTIPOLE TRANSITIONS. II. RANDOM PHASE APPROXIMATION. Siegel, S.; Zamick, L. (Rutgers - The State Univ., New Brunswick, N. J.). Phys. Lett., 28B: 453-4(Jan. 20, 1969).

The effective charge calculated in first order is too small. Random phase approximation (RPA) calculations were performed. These increase the isoscalar and decrease the isovector charges, but the isoscalar enhancement is so large that the RPA results cannot be believed. (auth)

17138 TESTS OF THE PERIPHERAL MODEL FOR A CLUSTER KNOCKOUT REACTION. Pugh, H. B.; Watson, J. W.; Goldberg, D. A.; Roos, P. G.; Bonbright, D. I.; Riddle, R. A. J. (Univ. of Maryland, College Park). Phys. Rev. Lett., 22: 408-12(Mar. 3, 1969).

The reaction ^{6}Li$(\alpha,2\alpha)$d was studied at 50.4, 59.0, 60.5, 70.3 and 79.6 MeV. The angular distributions and energy dependence of the off-energy-shell α-α cross section were extracted and compared with those for free α-α scattering. The agreement between the two is excellent, as predicted by the peripheral model in the quasifree approximation, but the quasifree approximation is not precise enough. (auth)

17139 DYNAMICAL BARRIER OF THE FISSION PROCESS. Gadioli-Erba, E.; Sona, P. G. (Laboratori Centro Informazioni

Studi Esperienze, Milan. Univ., Milan). Phys. Rev. Lett., 22: 406-7(Mar. 3, 1969).

The dynamical fission barrier is discussed, and the theoretical plausibility of the barriers used in statistical-model calculations is shown. (auth)

17140 MULTI-CONFIGURATION HARTREE–FOCK THEORY IN NUCLEI. Faessler, Amand (Univ., Muenster, Ger.); Plastino, A. Z. Phys., 220: 88-100(1969).

A variational method for the self-consistent solution of the nuclear many body problem with the inclusion of correlations is formulated. The trial function in this multiconfiguration Hartree–Fock (MCHF) theory is a linear combination of unrestricted Slater determinants. The MCHF equations are given, and a simple procedure for solving them is outlined. A great advantage of this method is that it also yields the excited states. It is shown that the trial function is stable against particle-hole excitations. Therefore, the Slater determinants differ from each other at least by two particle—two hole excitations. This method is applied to the Lipkin model. In the MCHF method the difference to the exact solution is reduced by a factor of three to ten compared with the corresponding value in the HF approach. (auth)

17141 MULTILEVEL DESCRIPTION OF THE ENERGY STRUCTURE OF NEUTRON CROSS SECTIONS. Luk'yanov, A. A.; El'-Vakil, S. A. At. Energ. (USSR), 25: 435-6(1968). (In Russian).

A detailed description of regularities in the energy structure of cross sections in the resonance region can be used directly in studying the space-energy distribution of fast neutrons in a medium. Py using the formalism of Wigner, it is possible to assign average parameters to the general problem that do not depend on energy. An expression is derived for the interaction cross section as a function of the maximum cross section at resonance, the phase of the potential scattering, position of the level, and width of the resonance. The energy structure of the cross section is analyzed in the presence of interference of the resonance and potential scattering, and of interference between resonances as a function of the distance between levels. It is concluded that at small values of the distance between levels, the form of the resonances and their widths differ noticeably from the case of isolated resonances. The minimum between resonances remains unchanged even when the level width exceeds the distance between resonances. With decreasing distance between levels, the distance between observed maxima in the cross section tends to a definite limit. These effects on the neutron cross section should be taken into account in the energy region where the widths become comparable in magnitude with the distances between resonances. Functionals of the cross section which have been averaged over many levels can be obtained by averaging the corresponding expressions both according to energy, and also according to the distribution of the resonance parameters. (TTT)

17142 MULTI-ELECTRON CORRELATIONS IN INTERNAL CONVERSION. Amus'ya, M. Ya.; Listengarten, M. A.; Shapiro, S. G. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1703-8(1968). (In Russian).

The effects of electron interactions in the internal conversion process were studied. Corrections were obtained which account for the probability of internal conversion in E1 transitions involving multiparticle effects in Z = 35 and 63 nuclei. The results show the importance of considering electron interactions in studies of internal conversion in low-energy transitions. (R.V.J.)

17143 EFFECTIVE NUCLEAR POTENTIAL OF THE INTERACTION BETWEEN TWO NUCLEONS IN TRIPLET STATES. Florczak, J. (Univ. of Lodz, Poland). Acta Phys. Pol., 34: 833-6(Nov. 1968).

It is shown that by taking into consideration the results of Tharrats et al., one can derive in a very simple manner the nucleon–nucleon interaction given usually derived by more complicated method. (auth)

17144 THE SPURIOUS STATES PROBLEM AND AN EXTENSION OF THE RPA. da Providencia, J. (Univ., Coimbra); Shakin, C. M. Port. Phys., 5: No. 1/2, 31-47(1967–68).

Corrections to RPA transition amplitudes arising from ground-state correlations due to the zero point motion of the several degrees of freedom have been considered elsewhere. Since a complete set of states was required in the derivations the zero point motion of the spurious degrees of freedom was also involved in the expressions obtained for transition amplitudes. It is shown here that the contribution of the spurious states actually cancels out in those expressions if the transition operator commutes with collective operators such as center of mass position and total momentum. (auth)

17145 FADDEEV EQUATIONS FOR AN N-TERM SEPARABLE POTENTIAL. Stagat, R. W. (Rensselaer Polytechnic Inst., Troy, N. Y.). Nucl. Phys., A125: 654-64(1969).

Previous derivations of the appropriate form of the Faddeev equations for a separable potential were generalized to include an arbitrary number N of separable terms in each spin state and to permit a possible energy dependence in each term. The resulting equations are a set of 3N coupled integral equations for the 3N spectator functions. Following Fuda, the operators of the permutation group S_3 were introduced to simplify the handling of the equations. (auth)

17146 AN EXPLICIT EXPRESSION FOR THE AVERAGE TOTAL WIDTH OF COMPOUND LEVELS. Eberhard, K. A. (Max-Planck-Institut fuer Kernphysik, Heidelberg); Von Brentano, P.; Boehning, M.; Stephen, R. O. Nucl. Phys., A125: 673-83(1969).

A simple and explicit expression is presented for the total nuclear level width $\Gamma_j(E_x)$ as a function of the excitation energy E_x and of the total angular momentum J of a highly excited compound nucleus. The J-dependence of Γ was found to be mainly due to the difference of the spin cutoff parameters σ_C^2 and σ_{res}^2 of the compound nucleus and of the residual nuclei, respectively. Using this formula, a simplified Hauser-Feshbach expression for the average cross sections was obtained. (auth)

17147 ANGULAR DISTRIBUTION OF NUCLEAR RECOILS AND OF EMITTED NEUTRONS IN MUON CAPTURE. Devanathan, V.; Rose, M. E. (Univ. of Virginia, Charlottesville). Contract AT(40-1)-2915. J. Math. Phys. Sci., 1: 137-58(Oct. 1967). (ORO-2915-81).

A survey of the research on the angular distributions of recoils and neutrons emitted in the capture of polarized muons by nuclei with zero spin is presented. The role of parity non-conservation in the asymmetry of the angular distributions is discussed in detail. (D.C.W.)

REACTOR TECHNOLOGY

Commercial Power Reactors

Refer also to abstracts 16464 and 17248.

17148 (BNWL-SA-2279) AN INDEPENDENT VIEW OF THE THERMAL EFFECTS AND RADIOACTIVE RELEASES FROM NUCLEAR POWER PLANTS. Jaske, R. T. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 1969. Contract AT(45-1)-1830. 30p. (CONF-690105-1). Dep. CFSTI.

From Seminar on Hydrologic Problems, Missoula, Mont.

The effects of thermal releases from power reactors on environment and public safety are discussed from a legal aspect point-of-view. Comparative trends in power reactor thermal release effects on river temperatures are presented for 1960 to 1966. The effects of heat rejection temperatures on various power cycles are illustrated. (D.C.C.)

17149 (DOCKET-50220-2) NINE MILE POINT NUCLEAR STATION. Final Safety Analysis Report, Amendment 3, Part 1. (Niagara Mohawk Power Corp., Syracuse, N. Y.). July 17, 1967. 79p. Dep. CFSTI.

Revised pages for the Final Safety Analysis Report (FSAR) for Nine Mile Point Power Reactor, Unit 1 are included. Sections 3 through 12 of the FSAR are revised; however, primary changes pertain to: engineered safeguards, containment, and control systems and instrumentation. (M.L.S.)

17150 (DOCKET-50220-9) NINE MILE POINT NUCLEAR STATION. Final Safety Analysis Report, Amendment 2, Vol. 1, Exhibit D-2. (Niagara Mohawk Power Corp., Syracuse, N. Y.). June 1, 1967. 606p. Dep. CFSTI.

Information on Nine Mile Point Power Reactor, Unit 1 is given on the following broad topics: Introduction and Summary; Station Site and Environment; Buildings and Structures; Reactor; Reactor Coolant System; Containment System; Engineered Safeguards; Instrumentation and Control; Electrical Systems; Reactor Auxiliary and Emergency Systems; Steam to Power Conversion System; Radiological Controls; Conduct of Operations; Testing and Operation; and Safety Analyses. (M.L.S.)

17151 (DOCKET-50220-10) NINE MILE POINT NUCLEAR STATION. APPENDIXES. Final Safety Analysis Report, Amendment 2, Vol. 2, Exhibit D-2. (Niagara Mohawk Power Corp., Syracuse, N. Y.). June 1, 1967. 369p. Dep. CFSTI.

Detailed meteorologic, hydrologic, geologic, and seismologic analyses for the Nine Mile Point Power Reactor are included. Wind patterns, lapse rate distributions, turbulence classes, and diffusion parameters are given; data are presented in tabular and graphic form. Dilution of station effluent is evaluated; a preliminary study of lake biota off Nine Mile Point is included. Effluent dilution is calculated for eastward lake currents based on water availability. Additional studies on geologic, hydrologic, and seismologic characteristics are correlated with previous studies; some test pile data are included. Station effluent discharge limits are specified for gaseous and liquid matter. The environmental monitoring program is described. Reactor boundary and standby safeguards analyses are detailed. (M.L.S.)

17152 (DOCKET-50220-11) NINE MILE POINT NUCLEAR STATION. TECHNICAL SPECIFICATIONS. Final Safety Analysis Report, Amendment 3, Vol. 3, Exhibit D-2. (Niagara Mohawk Power Corp., Syracuse, N. Y.). July 18, 1967. 57p. Dep. CFSTI.

The complete Technical Specifications for the Nine Mile Point Reactor, Unit 1 are given. The Technical Specifications are organized and tabulated as they pertain to a given system; a summary statement of the basis for each specification is included. (M.L.S.)

17153 (DOCKET-50220-12) NINE MILE POINT NUCLEAR STATION. SPECIAL TOPICAL REPORTS. Final Safety Analysis Report, Amendment 4, Vol. 4, Exhibit D-2. (Niagara Mohawk Power Corp., Syracuse, N. Y.). Sept. 11, 1967. 136p. CFSTI.

Applicability of formal codes and pertinent certifications for the Nine Mile Point Power Reactor, Unit 1 is evaluated. Systems or components considered are: reactor vessel, pressure suppression containment, and engineered safeguards. Design analyses and summaries of the inspection and test reports are included for the pressure vessel and containment; surveillance provisions for the pressure vessel are summarized. Seismic and stress calculations to determine response of the containment and core spray piping systems are detailed; the mathematical model is described. Adequacy of the containment spray system is evaluated; test results are summarized. Code approval calculations are summarized. (M.L.S.)

17154 (DOCKET-50220-13) NINE MILE POINT NUCLEAR STATION. Final Safety Analysis Report, Amendment 5, Suppl. 1, Exhibit D-3. (Niagara Mohawk Power Corp., Syracuse, N. Y.). May 20, 1968. 181p. Dep. CFSTI.

The quality control program used during the construction of the Nine Mile Point Power Reactor, Unit 1 is described. A detailed analysis of the Emergency Core Cooling Systems (ECCS) performance is given; data and calculations are shown graphically. Net positive suction head availability to torus pumps is evaluated; pumping rates are shown as a function of water temperature; integrated decay heat is shown as a function of time. Instrumentation, controls and interlocks for the ECCS are discussed; prevention of flooding of ECCS pumps is described. Stress loading analyses for the core spray piping and sparger ring located in the pressure vessel are given; induced stresses are tabulated. Reactor coolant leakage into the drywell is discussed. Loss of off-site power and response of ECCS is considered. Quality control tests and inspections of the cooling system are tabulated. Core thermal and hydraulic characteristics are summarized. Safety functions of radiation monitors are listed. Facilities which permit continuous occupancy of the control room following a design basis accident are described. A failure mode and effects of the a-c system are given; results are tabulated. Sequential operation of circuit breakers connecting various power sources to the distribution system is described. Various aspects of the diesel generator system are considered. Off-gas release rates are tabulated; fission product transport to the suppression pool during an accident is described. Effects of a delay in startup of the emergency ventilating system are evaluated. A detailed outline of the plant emergency plan is given. Proposed station operating procedures are outlined. (M.L.S.)

17155 (DOCKET-50245-8) [MILLSTONE NUCLEAR POWER STATION, UNIT 1]. Final Safety Analysis Report, Amendment 11. (Connecticut Light and Power Co., Hartford. Hartford Electric Light Co., Conn. Western Massachusetts Electric Co., Greenfield. Millstone Point Co., Wethersfield, Conn.). Jan. 24, 1969. 49p. Dep. CFSTI.

The complete quality assurance report for Millstone Point Power Reactor, Unit 1 is included. Management and organizational responsibilities are given. Quality assurance activities are described; quality compliance is documented. Critical systems are tabulated; major subcontractors and suppliers of major equipment are listed. The division of work between GE-APED and Ebasco Services, Inc. is tabulated. (M.L.S.)

17156 (DOCKET-50286-15) INDIAN POINT NUCLEAR GENERATING UNIT NO. 3. Preliminary Safety Analysis Report, Amendment 12. (Consolidated Edison Co. of New York, Inc., New York). Feb. 27, 1969. 45p. Dep. CFSTI.

Extension of the construction completion date for Indian Point Power Reactor, Unit 3 is included. A current list of directors and principal officers for Consolidated Edison is given; the 1967 Annual Report is included. (M.L.S.)

17157 (DOCKET-50293-18) PILGRIM NUCLEAR POWER STATION. [Design and Analysis Report], Amendment 10. (Boston Edison Co., Mass.). Mar. 26, 1968. 7p. Dep. CFSTI.

Brittle fracture prevention in ferritic steel parts of the Pilgrim Power Reactor cooling system is discussed. Tornado design criteria for the reactor building are given; wind velocity envelopes are shown. (M.L.S.)

17158 (DOCKET-50293-19) PILGRIM NUCLEAR POWER STATION. Design and Analysis Report, Amendment 1. (Boston Edison Co., Mass.). July 21, 1967. 29p. Dep. CFSTI.

Financial data on the Boston Edison Company, owners of Pilgrim Power Reactor, are given. Balance sheets for assets and liabilities and capitalization are given as of December 31, 1966. Bond and economic management information are included. (M.L.S.)

17159 (DOCKET-50315-13) DONALD C. COOK NUCLEAR PLANT. Preliminary Safety Analysis Report, Amendment 9. (Indiana and Michigan Electric Co., Fort Wayne, Ind.). Oct. 30, 1968. 3p. (DOCKET-50316-13). Dep. CFSTI.

Operation of the three motor-operated valves used in the boric acid injection system is discussed. (M.L.S.)

17160 (DOCKET-50315-14) DONALD C. COOK NUCLEAR PLANT. Preliminary Safety Analysis Report, Amendment 10.

(Indiana and Michigan Electric Co., Fort Wayne, Ind.). Nov. 14, 1968. 43p. (DOCKET-50316-14). Dep. CFSTI.

Supplemental quality control information for the Donald C. Cook Power Reactors, Units 1 and 2, is given. Cadweld splicing and testing procedures are listed; seismic design criteria are included. Recombiner design and the associated research and development are detailed. Additional information on the ice condenser doors is given. The containment spray research and development program is detailed. (M.L.S.)

17161 (DOCKET-50315-15) DONALD C. COOK NUCLEAR PLANT. Preliminary Safety Analysis Report, Amendment 11. (Indiana and Michigan Electric Co., Fort Wayne, Ind.). Nov. 27, 1968. 121p. (DOCKET-50316-15). Dep. CFSTI.

Revised or additional information on the Donald C. Cook Power Reactor, Units 1 and 2 is given on: in-service inspection of the reactor vessel; acceptance standards, inspection, and testing of the Cadweld joints and splices; ice condenser doors; boric acid injection tank; Emergency Core Cooling System (ECCS) design expectations; effects of nitrogen from the accumulators during a coolant loss accident; and calculational models for accident analyses. The hydrogen recombiner system for the ECCS is detailed. Organization and management of the quality assurance program is described. (M.L.S.)

17162 (DOCKET-50317-9) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 6. (Baltimore Gas Electric Co., Md.). Jan. 13, 1969. 85p. (DOCKET-50318-9). Dep. CFSTI.

The containment structure iodine removal system for the Calvert Cliffs Power Reactor, Units 1 and 2, is described. The safety injection system actuation is discussed; logic diagrams are shown. Schematics of the spent fuel cooling system and plant and containment ventilation systems are included. The gaseous waste processing system is described; a flow diagram is included. Analytical procedures and methods used for hypothetical accident hazards are described; cumulative thyroid and whole body immersion doses are plotted as a function of distance downwind for 2 hour, 24 hour, and 30 day exposures. Effects of tide and storm surge are analyzed in detail; data are shown graphically. (M.L.S.)

17163 (DOCKET-50322-7) SHOREHAM NUCLEAR POWER STATION, [UNIT 1]. [Preliminary Safety Analysis Report], Amendment 3. (Long Island Lighting Co., [Mineola], N. Y.). Feb. 5, 1969. 27p. Dep. CFSTI.

Vulnerability of the Shoreham Power Reactor site to possible crashes of airplanes from nearby airfields is evaluated in detail. Crash data are shown graphically. Crash probabilities and crash patterns around airports are discussed. (M.L.S.)

17164 (DOCKET-50331-8) DUANE ARNOLD ENERGY CENTER. Preliminary Safety Analysis Report, Amendment 2. (Iowa Electric Light and Power Co., Cedar Rapids). Feb. 19, 1969. 101p. Dep. CFSTI.

Design changes in the cooling system of the Duane Arnold Power Reactor are described. The multibarrier pressure-suppression containment system is discussed in detail; operation of and conditions for drywell, penetrations, venting and air conditioning systems, and valves are specified. The waste processing systems are described; operational design basis for the gaseous radwaste system is presented. Revised flow diagrams for main and extraction steam systems and for the condensate and reactor feedwater system are included; these are discussed. A hypothetical fuel melting accident is reevaluated; fission product diffusion by wind under accident conditions is considered. (M.L.S.)

17165 (HPR-86) BURN-UP EXPERIMENTS WITH THE HBWR SECOND FUEL CHARGE. Blomsnes, B.; Danielsson, B.; Gustavsson, V.; Johansson, E.; Keaten, R. W.; Korpas, T. H.; Lunde, J. E.; Olsen, H. Smidt; Svensson, P.; Trengereid, J. K. (Institutt for Atomenergi, Halden (Norway). OECD Halden Reaktor Prosjekt). Sept. 1968. 114p. Dep.

Burnup experiments performed on the Halden Boiling Reactor second fuel charge include: isotopic analysis; integral cross section measurements; neutron transmission measurements; spectral indices and initial conversion ratio; gamma scanning measurements; and measurement of the critical size and reactivity coefficients of the burned core. 29 references. (D.C.C.)

17166 (NP-17767) ILLUSTRATIVE POWER REACTOR PROGRAMMES. Prospects for Nuclear Energy in Western Europe. (European Nuclear Energy Agency, Paris (France)). May 1968. 43p. Dep.

Information is given on the predicted nuclear power requirements for Western Europe from 1970 to 2010. Revised basic reactor data are presented. The forecasted reactor types for development and application in Western Europe are listed. The fuel requirements and available resources for 1970 to 2010 are presented with revised reactor performance data. (D.C.C.)

17167 (NP-17767(App.)) ILLUSTRATIVE POWER REACTOR PROGRAMMES. Prospects for Nuclear Energy in Western Europe. (European Nuclear Energy Agency, Paris (France)). May 1968. 50p. Dep.

Appendices contain information on: Pu, Th, and U requirements during 1990, 2000, and 2010; effects on fabrication and reprocessing capacities on fuel economics for 2001 to 2010; and summaries of computer programs for forecast requirements. (D.C.C.)

17168 (TID-24961) GARIGLIANO NUCLEAR POWER PLANT. Operation Report for the 3rd Quarter of 1968. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). Sept. 30, 1968. 21p. Dep. CFSTI.

Topics discussed include: General Plant Condition; Plant Operation; Core Performance; Plant Chemistry; Health Physics; Work Performed During Shutdown; Primary Circuit Inspections and Controls; and Experiments Under the Plutonium Research Program. (D.C.C.)

17169 (WAPD-Trans-113) FUNDAMENTALS AND CONSTRUCTION OF THE FIRST NUCLEAR POWER PLANT WITH DIRECT CYCLE GAS TURBINE (GEESTHACHT). Keller, Curt. Translated for Bettis Atomic Power Lab., West Mifflin, Pa., from Brennst.-Waerme-Kraft, 20: 257-9(1968). 12p. Dep. CFSTI.

After a brief characterization of helium as the operating medium for closed gas turbine processes, the design of the Geesthacht nuclear power plant, 25 MW(e) output, is described. This installation can serve as the industrial prototype for subsequent large scale installations with a high temperature reactor and directly coupled helium gas turbine. (auth)

17170 DYNAMIC TESTS ON THE MZFR. Frei, G.; Rauscher, Th. (Siemens Aktiengesellschaft, Erlangen, Ger.). Atomkernenergie, 14: 81-93(Mar.-Apr. 1969).

During the start-up phase of the MZFR numerous dynamic tests were made in the entire power range between zero power and full power to test the behavior of the plant in normal operation and on disturbances. The most important test results are explained with the aid of diagrams and compared with the results of an analog computer study carried out in the design stage. A brief description is given of the plant control systems and of the analog computer model. (auth)

17171 TRAVELLING CRANE ABOVE THE REACTOR POOL OF ELECTRICITE DE FRANCE III NUCLEAR POWER PLANT AT CHINON. Manutention-Stockage, No. 133, 129(Jan. 1967). (In French).

This crane is used to handle the storage plates of the irradiated fuel element containers both full and empty, between the various storage or working stations, in a minimum protective depth of water of 3.8 m. It consists of a frame built up by welding from welded box girders, a traversing mechanism, a welded section and tube carriage, a steering mechanism, a hoisting mechanism, a clip opening mechanism and a stripping down bracket. The characteristics are listed. (UKAEA Info. Bull.)

17172 SOVIET NUCLEAR POWER. Morokhov, Igor. Energ. Nucl. (Paris), 10: 423-7(Nov. 1968). (In French).

Various types of nuclear reactors for power plants have been studied in USSR: uranium-graphite reactors; PWR; and BWR. A full scale fast reactor is under construction at Chevtchenko. Technical progress makes the nuclear power plant economical in certain parts of USSR. (auth)

17173 LIGHTING THE NUCLEAR LANTERN IN NIPPON. McCool, Whittie J. Power, 113: No. 3, 78-81(Mar. 1969).

A description of Japan's nuclear power plant growth is presented. Characteristics of the power reactors planned through 1976 are presented. (D.C.C.)

17174 SOME COMPARISONS OF MEASURED AND PREDICTED PRIMARY RADIATION LEVELS IN THE AGESTA POWER PLANT. Aalto, E.; Sandlin, R.; Krell, A. (Aktiebolaget Atomenergi, Stockholm). Nucl. Eng. Design, 8: 391-401(Sept.-Oct. 1968).

Neutron fluxes and gamma exposure rates in the primary shields of the Ågesta nuclear plant were measured and the results compared with values predicted during shield design, and with values obtained later by the NRN bulk shielding code. The input data for the problems are given. The radial predictions are conservative by a factor of not more than 2 close to the reactor and by an unknown, higher factor further out. The conservation is explainable by the differences between the true local conditions and core power distributions and those assumed in the predic-

tions. The axial flux levels based on streaming calculations are found to agree quite well with the estimated values. The conservatism here is not so large and it seems to be necessary to be very careful when handling streaming problems. The experience gained shows that a power plant is less suitable for studying the accuracy of the shield design codes as such, but the practical results from the combined application of massive shield codes and void streaming predictions to complicated problems give information about the true degree of conservatism present. 8 references. (auth)

Power Reactor Development

17175 (BNWL-936(Vol.1)) POWER REACTOR DESIGNS. VOLUME 1. GLOSSARY, SECTIONS AD-EF. An Annotated Bibliography. Appleby, E. R. (comp.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 1969. Contract AT(45-1)-1830. 399p. Dep. CFSTI.

An annotated bibliography of power and heat reactor design studies is presented. Reactor types included consist of foreign and domestic: aqueous homogeneous and molten salt reactors; boiling light water reactors; cavity (gas core) reactors; gas-cooled reactors; and heavy water-moderated reactors. (D.C.C.)

17176 (DOCKET-50144-1) CONCERNING THE CONSTRUCTION AND OPERATION OF A NUCLEAR STEAM GENERATING PLANT AT PARR, SOUTH CAROLINA. Application for AEC Licenses, General Information. (Carolinas Virginia Nuclear Power Associates, Inc., Charlotte, N. C.). July 9, 1959. 42p. (CVNA-26). Dep. CFSTI.

The application for license for the Carolinas-Virginia Tube Reactor (CVTR) is given. Officers, Directors, and sponsoring companies of the Carolinas Virginia Nuclear Power Associates, Inc. (CVNPA), owners of the CVTR are listed. Financial data on CVNPA are given; projected costs of the reactor project are tabulated. Construction schedules are discussed; fuel balance sheets are projected through 1968. (M.L.S.)

17177 (DOCKET-50146-38) SAXTON REACTOR: APPLICATION FOR EXTENSION OF OPERATING LICENSE DPR-4. (Saxton Nuclear Experimental Corp., Pa.). Nov. 27, 1968. 41p. Dep. CFSTI.

The application for extension of the Saxton Reactor operating license contains financial data on the Saxton Nuclear Experimental Corporation, owners of the Saxton Reactor. The 1967 Annual Report of the General Public Utilities is included, also. (M.L.S.)

17178 (EURFNR-582) PRAWDA: A FORTRAN PROGRAM FOR THE THERMAL DESIGN OF STEAM AND GAS COOLED REACTORS. Doetschmann, K.; Hofmann, F.; Kirsch, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Translation of report KFK-725. 60p. Dep. CFSTI.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

The FORTRAN computer program PRAWDA is designed to calculate the pressure and temperature curves in cooling channels as a basis for steam-cooled and gas-cooled reactor designs. (D.C.C.)

17179 FUTURE PROSPECTS FOR NUCLEAR POWER STATIONS OF SMALL AND MEDIUM OUTPUT. Huenlich, Werner H. F. (Kernenergie bei der Vereinigung Deutscher Elektrizitaetswerke, Frankfurt am Main); Kruck, Peter H. At. Strom, 14: 149-53(Oct. 1968). (In German).

The present and future demand for nuclear power stations of small and medium output in the world are reviewed. Possible methods of reducing the cost of nuclear power stations in the lower power range are examined. (auth)

17180 THE PRESENT STATE OF NUCLEAR POWER GENERATION, AND ITS FUTURE. Tsuzuki, Takashi. Doryoku, 17/18: 302-6(Feb. 1968). (In Japanese).

The nuclear power generation in Japan is described in the following: the present state of nuclear power generation; domestic production of power reactors, and the development of advanced power reactors; and, measures for nuclear fuel supplies. (NSA of Japan)

17181 ON THE DEVELOPMENT PROGRAM OF POWER REACTORS OF POWER REACTOR AND NUCLEAR FUEL DEVELOPMENT CORP. IN THIS YEAR. Kuramoto, M. Doryoku, 18: No. 104, 28-31(July 1968). (In Japanese).

Power Reactor and Nuclear Fuel Development Corp. was established in autumn 1967, and it was decided to promote the development of heavy water moderated conversion reactors and Na-cooled fast breeder reactors. In April 1968, the first basic program was developed. The purposes of the program are: to utilize effectively nuclear fuel, to display utmost advantages in nuclear power generation, to strengthen foundations of our domestic industries, and to raise technical and scientific levels. The new conversion reactor uses natural U fuel and is moderated with heavy water. It is cooled with boiling light water. The prototype reactor of about 200,000 kW output is being constructed to reach criticality in 1974. The fast breeder reactor uses fuel of oxide mixture of Pu and U, and the Na-cooled reactor is the target of development. The experimental reactor of about 100,000 kW output is expected to reach criticality in 1972, and the prototype reactor of about 200,000 to 300,000 kW output will go critical in 1976. (NSA of Japan)

Kinetics and Dynamics

17182 (ORNL-TM-2459) SENSITIVITY OF GAS AND STEAM-COOLED-FAST REACTOR BREEDING RATIOS TO UNCERTAINTIES IN ^{239}Pu CROSS SECTIONS. Ritts, J. J.; Bennett, L. L.; Welfare, F. G. (Oak Ridge National Lab., Tenn.). Feb. 12, 1969. 23p. Dep. CFSTI.

A study was made to determine the effect of increases in capture cross sections of ^{239}Pu (with respect to ENDF/B data) on breeding ratios and fissile loadings of fast reactors. Two sets of comparisons were made showing significant reductions in breeding ratios and increases in fissile loadings. 12 references. (auth)

Control Systems

Refer also to abstract 16190.

Cooling Systems

Refer also to abstracts 16460, 16471, 16472, and 16481-16483.

17183 (CONF-670916-4) SAFETY PROBLEMS WITH SINGLE WALL SODIUM/ WATER HEAT EXCHANGERS FOR FAST REACTORS. Poplavskii, V. M.; Aristarkhov, N. N.; Bagdasarov, Yu. E.; Blagovolin, S. M.; Vyblov, N. F.; Pinkhasik, M. S. Translated by B. Robertson (Dounreay Experimental Reactor Establishment, Caithness, Scotland), from Proceedings of the International Conference on the Safety of Fast Reactors, Aix-en-Provence, September 19-22, 1967. 14p. Dep.

The safety problems involved in the use of Na and H_2O liquid-liquid heat exchangers for liquid Na-cooled fast reactors are analyzed. Experimental injections of H_2O into liquid Na were performed to study: effect of shock; hydrodynamic phenomena in the loop; effect of the hydraulic characteristics of the loop on structural overloading; thermal effects of the reaction; efficiency of the reaction product evaluation system; and deformation and deterioration of the structural components. 6 references. (D.C.C.)

17184 CARBON-DIOXIDE COOLED, GRAPHITE-MODERATED NUCLEAR REACTOR. Campion, Peter (to United Kingdom Atomic Energy Authority). U. S. Patent 3,427,221. Feb. 11, 1969. Priority date Nov. 16, 1965, Great Britain.

A Co_2 coolant circuit of a graphite-moderated nuclear reactor is provided with a catalyst bed containing Ni to promote the formation of methane from CO and H_2 in the coolant circuit to reduce the corrosive effects of the CO_2 coolant on the reactor graphite. (Offic. Gaz.)

17185 CROSS MIXING BY NATURAL TURBULENCE IN FUEL-ELEMENT BUNDLES. Baumann, Walter (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Atomkernenergie, 14: 107-11(Mar.-Apr. 1969).

Coolant cross mixing in the core exerts a significant influence on the thermal design of steam-cooled fast reactors. Natural cross mixing makes part of cross mixing; contrary to cross mixing directed by fins, natural cross mixing is solely determined by the velocities of fluctuation of the turbulent flow. Information on the regularity and order of magnitude of natural cross mixing is obtained by a statistic calculational model. (auth)

Fuels

Refer also to abstracts 16511 and 16546.

17186 (EURFNR-571) FUEL ELEMENTS WITH SPIRAL SPACERS FOR FAST BREEDER REACTORS. Baumann, W.; Casal, V.; Hoffmann, H.; Moeller, R.; Rust, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente). Translation of report KFK-768. 107p. Dep. CFSTI.

Work performed under United States–Euratom Fast Reactor Exchange Program.

Optimum design parameters for steam-cooled fast reactor hexagonal-shaped fuel elements with spiral spacers are analyzed. The spiral spacers investigated include: a wire wound around each fuel rod; 3 integral spiral fins; and 6 integral spinal fins. The mechanical, thermo- and hydrodynamic properties for each type of spacer configuration are compared. 14 references. (D.C.C.)

17187 (EURFNR-586) CONSISTENT TREATMENT OF INFLUENCE OF NEW ^{239}Pu ALPHA VALUES OF NUCLEAR CHARACTERISTIC QUANTITIES, ALLOWING FOR PLUTONIUM EQUILIBRIUM ISOTOPE COMPOSITION (Pu_{eq}). Kiefhaber, E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Translation of report KFK-846. 11p. Dep. CFSTI.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

New $^{239}Pu-\alpha$ data is presented. The effects of this data on the breeding potential of fast breeder reactors are discussed. The decline in the predicted breeding potential is analyzed with the associated Pu_{eq} composition. The nuclear parameters of a steam-cooled fast breeder reactor with and without allowance for Pu_{eq} composition are presented. 14 references. (D.C.C.)

17188 (GA-8107) GAS-COOLED FAST BREEDER REACTOR. Annual Progress Report for the Period Ending July 31, 1967. (Gulf General Atomic, Inc., San Diego, Calif.). June 25, 1968. Contract AT(04-3)-167. 537p. Dep. CFSTI.

CRITICAL ASSEMBLIES—criticality of plutonium oxide (PuO_2)–polystyrene compacts, effects of composition and configuration on
—criticality of plutonium oxide (PuO_2) and plexiglas slabs, effects of configuration on
—criticality of bare plutonium oxide (PuO_2), effects of configuration and composition on

CRITICALITY STUDIES—measurement of plutonium oxide (PuO_2)–polystyrene compacts, effects of composition and configuration on
—measurement of plutonium oxide (PuO_2) and plexiglas slabs, effects of configuration on
—measurement of bare plutonium oxide (PuO_2), effects of composition and configuration on

HASTELLOY X—cladding for gas-cooled fast breader power reactor plutonium oxide (PuO_2)–uranium oxide (UO_2) vented-type fuel elements, fabrication of
—cladding of uranium oxide fuel elements, testing of compatibility with fuel of
—radiation effects on, analysis of fast neutron

NEUTRONS—effects on mechanical properties of vented-type plutonium oxide (PuO_2)–uranium oxide (UO_2) fuel elements

NEUTRONS, FAST—effects on Hastelloy X-clad plutonium oxide (PuO_2)–uranium oxide (UO_2) vented-type fuel elements

ORNL RESEARCH REACTOR—core configuration for vented-type plutonium oxide (PuO_2)–uranium oxide (UO_2) fuel elements, physics parameter calculations for

PLUTONIUM OXIDES PuO_2—PuO_2–UO_2, fuel element of stainless steel- and Hastelloy X-clad sintered, fabrication of gas-cooled fast breeder power reactor vented-type
—PuO_2–UO_2, fuels of, radiation effects on mechanical properties of, neutron
—PuO_2–UO_2, fuel elements of, radiation effects on sintered, vented-type fast neutron
—polystyrene–PuO_2, compacts of, effects of composition and configuration on, criticality of
—criticality of bare and plexiglas separated slabs of, effects of composition and configuration on

REACTOR FUEL ELEMENTS—development of gas-cooled fast breeder power reactor plutonium oxide (PuO_2)–uranium oxide (UO_2), description of July 1966 to July 1967
—fabrication of stainless steel- and Hastelloy X-clad plutonium oxide (PuO_2)–uranium oxide (UO_2) vented-type
—cladding for vented-type uranium oxide (UO_2), testing compatibility of Type 304 stainless steel flex-can and Hastelloy X
—radiation effects on mechanical properties of vented-type plutonium oxide (PuO_2)–uranium oxide (UO_2), calculation of neutron
—radiation effects on Hastelloy X-clad plutonium oxide (PuO_2)–uranium oxide (UO_2) vented-type, analysis of fast neutron

REACTORS, BREEDER—fuel elements for gas-cooled fast power, development during July 1966 to July 1967 of
—core development for gas-cooled fast power, July 1966 to July 1967

REACTORS, FAST—fuel elements for gas-cooled breeder power, development during July 1966 to July 1967 of
—core development for gas-cooled breeder power, July 1966 to July 1967

REACTORS, GAS-COOLED—fuel elements for fast breeder power, development during July 1966 to July 1967 of
—core development for fast breeder power, July 1966 to July 1967

REACTORS, POWER—fuel elements for gas-cooled fast breeder, development during July 1966 to July 1967 of
—core development for gas-cooled fast breeder, July 1966 to July 1967

STAINLESS STEEL—cladding for gas-cooled fast breeder power reactor plutonium oxide (PuO_2)–uranium oxide (UO_2) vented-type fuel elements, fabrication of
—cladding of uranium oxide fuel elements, testing of compatibility with fuel of

STYRENE POLYMERS—polystyrene–PuO_2, compacts of, effects of composition and configuration on criticality of

URANIUM OXIDES UO_2—PuO_2–UO_2, fuel element of stainless steel- and Hastelloy X-clad sintered, fabrication of gas-cooled fast breeder power reactor vented-type
—fuel compatibility of Type 304 stainless steel flex-can and Hastelloy X clad, testing of compatibility with cladding of
—PuO_2–UO_2 fuels of, radiation effects on mechanical properties of, neutron
—PuO_2–UO_2 fuel elements of, radiation effects on sintered vented-type, fast neutron (D.C.C.)

17189 (IDO-17283) IMPROVEMENT OF THE X-Y CORE HEAT TRANSFER MODEL (MOXY) USING THERMAL SYMMETRY. Evans, D. R. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Dec. 1968. Contract AT(10-1)-205. 34p. Dep. CFSTI.

Two versions of the core heat transfer code, MOXY, have been developed. Both simulate heat transfer in a BWR fuel element; one models a full section of the fuel element, the other a one-eighth section by using symmetry. The codes give the same results, but the code using symmetry uses $^1/_{77}$th as much computer time on comparable problems and represents the section with 14 surfaces, rather than 81. On the basis of code performance, the symmetry model is a substantial improvement over the full-section model. The reduction in number of surfaces by a factor of more than five achieved by the symmetry model means that an x-y-z model with five axial levels using symmetry will consume approximately the same amount of core storage as an x-y model not using symmetry. Therefore, the use of symmetry allows the development of a detailed three-dimensional core heat transfer model for LOFT and large power reactors. 4 references. (auth)

17190 (TID-24956) CRITICAL HEAT FLUX IN A 9' LONG, CLOSELY SPACED, 19-ROD BUNDLE WITH AN UNHEATED CENTRAL ROD. Topical Report No. 9. Matzner, Bruce (Columbia Univ., New York. Engineering Research Labs.). Sept. 21, 1966. Contract AT(30-3)-187. 3p. Dep. CFSTI.

The effects of the central rod in the conceptual 250 MW boiling heavy water-moderated reactor core on the critical heat flux is analyzed. A comparison of data for the 19-rod bundle with a heated central rod and with an unheated central rod is presented. (D.C.C.)

17191 NUCLEAR REACTORS. Rennie, Compton Alexander; Lockett, George Edward; Acciarri, Pietro (to United Kingdom Atomic Energy Authority). U. S. Patent 3,427,220. Feb. 11, 1969. Priority date Nov. 24, 1964, Great Britain.

A nuclear reactor core is composed of driven fuel having a conversion ratio near to unity and being a net consumer of neutrons. Multiple channels containing a readily replacable driver fuel are provided which produce excess neutrons to maintain criticality during operation of the reactor. As the driver fuel pieces are replaced, the bulk of the core remains stationary for long periods, yet this latter portion also contributes to the power output of the core. (Offic. Gaz.)

17192 INTERNALLY PRESSURIZED FUEL ELEMENT. (to Westinghouse Electric Corp.). British Patent 1,143,708. Feb. 26, 1969. Priority date Feb. 13, 1967, United States.

MANGANESE OXALATES—use for gas-forming substance in pressurized-water reactor pellet-type sealed uranium oxide (UO_2) fuel elements

REACTOR FUEL ELEMENTS—pellet-type sealed gas-forming manganese oxalate decomposing gas-forming uranium oxide (UO_2), for pressurized-water reactors

REACTORS, PRESSURIZED WATER—fuel elements of manganese oxalate–uranium oxide (UO_2), description of sealed gas-forming pellets for

URANIUM OXIDES UO_2—fuel elements of sealed pellets of, on pressurized-water reactors, chemical reactions (D.C.C.)

17193 SPECIFIC NUCLEAR FUEL CONSUMPTION INDEX FOR ATOMIC POWER STATIONS. Batov, V. V.; Zelevinskii, G. S.; Koryakin, Yu. I. At. Energ. (USSR), 26: 61-2(Jan. 1969). (In Russian).

The mean burnup of the nuclear fuel is not a significant economic index by itself, although it enters in the cost of power generation, because it does not indicate the efficiency of utilization of the original raw material, natural U. Reprocessing and repeated use of the fuel must also be taken into account. The specific yield of natural U is defined as the ratio of the natural U used up in the preparation of the enriched material for a given fuel charge to the electric energy generated by that charge. A generalized equation was derived; it indicates that the fuel component of the energy cost is directly proportional to the specific natural U consumption and the fuel cost per unit weight of the fuel charge. In case of a closed cycle, based on the reuse of the remaining and newly created fuel material, the coefficient of recovery depends on the breeding ratio. The cost of the generated Pu depends on its isotopic composition and on the reactor type, in which the Pu is to be used. The value of the Pu is calculated on the basis of the change of the critical fuel loading and of the breeding ratio when ^{235}U is replaced by Pu. In thermal reactors, the energy value of Pu and of the ^{235}U may be assumed to be approximately equal. (TTT)

Auxiliary and Emergency Systems

17194 (CEA-R-3654) DETECTION AND LOCATION OF CAN RUPTURE IN REACTORS COOLED BY A FLOW OF WATER. Le Meur, Roger (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Nov. 1968. 26p. (In French). Dep.

The principal methods of fission-product detection used for water reactors are described. The position, type and method of adjustment are given for each detector. The methods for localizing the defective elements are explained, in particular those using water sampling or decreases in the flux. A few installations are briefly described. They correspond to particular types of reactors using boiling, pressurized or cold water. Among the many methods used, it can be noted that when the fuel is resistant the installations are fairly compact. In nuclear superheated reactors on the other hand, the study of fuel behavior calls for larger installations. An identification of defective elements exists when the reactor structure allows it. If this is not possible, a localization in a group of elements is obtained by a flux depression. 27 references. (auth)

17195 REFUELLING APPARATUS FOR A NUCLEAR REACTOR. Aubert, Michel; Gugenberger, Rene; Tissot, Roland (to Commissariat a l'Energie Atomique). British Patent 1,143,329. Feb. 19, 1969. Priority date Jan. 5, 1967, France.

REACTOR LOADING MACHINES—design of vertical-overhead pressure-vessel contained, for gas-cooled graphite-moderated reactors

REACTORS, GAS-COOLED—loading machine for graphite-moderated, description of vertical overhead pressure-vessel-contained

REACTORS, GRAPHITE-MODERATED—loading machine for gas-cooled, description of vertical overhead pressure-vessel-contained (D.C.C.)

17196 REQUIREMENTS TO BE MET BY FITTINGS IN NUCLEAR POWER STATIONS. Stuffer, M. (Gulde Regelarmaturen KG Ludwigshafen, Ger.). Brennst.-Waerme-Kraft, 21: 16-20(Jan. 1969). (In German).

Experience on the design of regulation and shut-off valves for almost all types of reactors and on the behavior in operation of such valves are reported. The data relate to materials problems, requirements as regards purity, tightness in shutting off and tightness to the outside as well as drive problems. (auth)

17197 THE DEVELOPMENT OF STEAM BLOWERS FOR STEAM-COOLED FAST BREEDER REACTORS. Erbacher, F.; Radtke, F. (Kernforschungszentrums, Karlsruhe, Ger.). Atomkernenergie, 14: 118-24(Mar.-Apr. 1969). (In German).

Good economy and safety of the steam-cooled fast breeder reactor require the fulfillment of stringent reactor engineering design criteria already at the design stage of the steam blowers. It is pointed out which specific criteria should be considered in the design and how they were implemented in the development of two novel experimental blowers. The experimental investigation of these blowers proved their functioning and operational safety and resulted in design data and indications for the development of large stream blowers for power reactors. (auth)

17198 METHOD AND DEVICE FOR THE REFUELLING OF NUCLEAR REACTORS. Mueller, Arno (to Gesellschaft fuer Kernforschung mbH). U. S. Patent 3,428,522. Feb. 18, 1969. Priority date Nov. 24, 1964, Germany.

A novel core element insertion and removal device is described for use in connection with nuclear reactors. The type of nuclear reactor particularly pertinent is one in which a core of fuel elements is provided, totally immersed in a liquid coolant, preferably a liquid sodium coolant. A core loading tube having a grasping or grappling means for mechanically lifting or lowering individual core elements is provided within the reactor which can be controlled from a remote source. A gas blanket is located above the level of liquid coolant, and a pumping or gas blower means is connected to the gas space above the coolant. When it is desired to change, remove or insert core elements, the gas pressure is increased in the reactor, whereby the liquid level is significantly reduced. The loading tube is positioned on top of a particular core element and the grasping or grappling means is engaged with the core element. Means are provided for varying the pressure within the loading tube so that as the core element is mechanically lifted from the core, the coolant level rises within the loading tube in order to provide a coolant bath completely covering the core elements, even after such has been extracted into the loading tube. (Offic. Gaz.)

Operation and Economics

Refer also to abstract 15829.

17199 (DOCKET-50146-11) SAXTON REACTOR OPERATIONS REPORT, MARCH 1-AUGUST 31, 1966. (Saxton Nuclear Experimental Corp., Pa.). Oct. 21, 1966. 43p. Dep. CFSTI.

A summary of operating experience for the Saxton Reactor is given for the period March 1, 1966, through August 31, 1966. Work is reported on a monthly basis on: experimental program, operational tests, maintenance, chemistry, radiation and waste disposal, and operating statistics. (M.L.S.)

17200 (DOCKET-50146-26) SAXTON OPERATING EXPERIENCE REPORT, MARCH 1-AUGUST 31, 1967. (Saxton Nuclear Experimental Corp., Pa.). Oct. 12, 1967. 40p. Dep. CFSTI.

A six months' operations report for March through August 1967 for the Saxton Reactor is presented. The material, presented by month, covers: the experimental program, operational tests, maintenance, chemistry, radiation and waste disposal, and operating statistics. (M.L.S.)

17201 (DOCKET-50146-33) SAXTON OPERATING EXPERIENCE REPORT, SEPTEMBER 1, 1967-FEBRUARY 29, 1968. (Saxton Nuclear Experimental Corp., Pa.). Apr. 19, 1968. 51p. Dep. CFSTI.

The six months' operations report for September 1967 through February 1968 is included. The material, presented on a monthly basis, covers: the experimental program, operational tests, maintenance, chemistry, radiation and waste disposal, and operating statistics. (M.L.S.)

17202 (DOCKET-50146-35) SAXTON OPERATING EXPERIENCE REPORT, MARCH 1-AUGUST 31, 1968. (Saxton Nuclear Experimental Corp., Pa.). Oct. 23, 1968. 48p. Dep. CFSTI.

The six months' operating report for the Saxton Reactor for March 1, 1968-August 31, 1968, is included. The material, presented on a monthly basis, covers: the experimental program, operations tests, plant modifications, maintenance, chemistry, radiation and waste disposal, and operating statistics. (M.L.S.)

17203 (DOCKET-50146-39) SAXTON REACTOR: LETTERS TO DIVISION OF REACTOR LICENSING ON OCCURRENCES AT SAXTON. (Saxton Nuclear Experimental Corp., Pa.). Nov. 26, 1968. 6p. Dep. CFSTI.

Information on the Saxton Reactor scram caused by pressure relief valve closure during attempted turbine roll is given. Included, also, is a description of a primary coolant system leak caused by deletion of gaskets in the housings of an experimental D/P cell-transmitter. The lack of gaskets had allowed housing penetration by primary coolart water; this, in turn, caused the detected erratic instrument response. (M.L.S.)

17204 PARAMETRIC STUDIES OF GAS COOLED FAST REACTORS WITH CLOSED CYCLE GAS TURBINES. Lys, L. A.; Brogli, R.; Heibling, W. (Swiss Federal Inst. for Reactor Research, Wuerenlingen, Switzerland). Atomkernenergie, 14: 75-80(Mar.-Apr. 1969).

For helium cooled fast reactors with direct cycle gas turbines, the criteria governing the design of the nuclear and power generating parts of the plant are very closely interrelated. In order

to examine these complex interrelationships, an optimization code was recently developed at the Swiss Federal Institute for Reactor Research. The code is described briefly and its application to the investigation of the impact of different design parameters such as plant efficiency or fissile inventory upon the optimum-plant characteristics is explained. Some examples of the application of the code to sensitivity studies are given. It is shown how optimum-plant characteristics depend upon economic ground rules such as interest rates and Pu price, and the extent to which the optimization results are influenced by the accuracy of the fuel fabrication cost estimate. (auth)

Safety and Siting

17205 (BMI–1856) AN EVALUATION OF THE APPLICABILITY OF EXISTING DATA TO THE ANALYTICAL DESCRIPTION OF A NUCLEAR-REACTOR ACCIDENT. Quarterly Progress Report, October–December 1968. Morrison, David L.; Carbiener, Wayne A.; Ritzman, Robert L. (Battelle Memorial Inst., Columbus, Ohio). Jan. 1, 1969. Contract W-7405-eng-92. 54p. Dep. CFSTI.

FISSION PRODUCTS—release of gaseous, effects of coolant loss accident on pin-type uranium oxide (UO_2) fuel element, (E/T)

IODINE ISOTOPES I-131—release of gaseous, effects of burnup on boiling reactor

REACTOR FUEL ELEMENTS—failure of ECCS Zircaloy-clad uranium oxide (UO_2), effects of coolant loss on crumbling, (E/T)

—fission product release from pin-type uranium oxide (UO_2), effects of coolant loss accident on, (E/T)

REACTOR SAFETY—coolant loss in reactors, on ECCS Zircaloy-clad uranium oxide (UO_2) fuel elements of, (E/T)

REACTORS, BOILING—fission product base in, effects of burnup on

URANIUM OXIDES UO_2—fuel elements for ECCS, effects of coolant loss on crumbling of Zircaloy-clad, (E/T)

—fission product release from fuel elements of, effects of coolant loss accident on, (E/T)

ZIRCALOY—cladding for ECCS uranium oxide (UO_2) fuel elements, effects of coolants loss on crumbling failure of, (E/T) (D.C.C.)

17206 (DOCKET-50146–1) SAFEGUARDS REPORT FOR THE SAXTON REACTOR PARTIAL PLUTONIUM CORE II. (Saxton Nuclear Experimental Corp., Pa.). Mar. 1965. 122p. Dep. CFSTI.

Information on the Saxton Reactor is given under the following broad topics: Introduction; Nuclear Design; Core Hydraulic and Thermal Design; Mechanical Design; Instrumentation; Accident Analysis; and Safety Considerations. (M.L.S.)

17207 (DOCKET-50146–2) SAXTON CHEMICAL SHIM EXPERIMENT. (Westinghouse Electric Corp., [Pittsburgh,] Pa. Atomic Power Div.). Aug. 1964. 92p. (WCAP–2599). Dep. CFSTI.

Details of the Saxton Reactor chemical shim experiment are given. The experimental program is described; results are summarized. The step-wise approach to power with the chemical shim is detailed; chemical shim effects on coolant pH and nucleate boiling are evaluated. Test assembly insertion and low power physics measurements are discussed. Reactivity follow measurements are analyzed in detail. The chemical surveillance program during use of the chemical shim is described. Chemical shim stability is analyzed. Data from coolant analyses are tabulated. pH effects on reactivity are analyzed. Flux distribution during chemical shim operations are discussed. (M.L.S.)

17208 (DOCKET-50146–3) SAXTON LOSS OF COOLANT ACCIDENT PREVENTION AND PROTECTION. ([Saxton Nuclear Experimental Corp., Pa.]). June 10, 1968. 173p. CFSTI.

A detailed analysis of a coolant loss accident for the Saxton Reactor is presented. The reactor coolant system is described; the emergency cooling system is detailed. Blowdown, core thermal, and containment transients are analyzed. The complete report on the Saxton pressure vessel is included. Multilayer construction of the pressure vessel is detailed. The computer programs used for coolant loss accident analyses are summarized. (M.L.S.)

17209 (DOCKET-50146–4) APPLICATION TO U.S. ATOMIC ENERGY COMMISSION FOR REACTOR CONSTRUCTION PERMIT AND OPERATING LICENSE. Preliminary Hazards Summary Report, Part B. (Saxton Nuclear Experimental Corp., Pa.). Mar. 1959. 142p. Dep. CFSTI.

Information on the Saxton Reactor is given under the following broad topics: Introduction and Summary; Description and Characteristics of Site; Description of Facility; Description of Operation: Accident Analysis; and Hazards Analysis. (M.L.S.)

17210 (DOCKET-50146–5) MULTI-LAYER CONSTRUCTION FOR THE SAXTON REACTOR VESSEL. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Dept.). Feb. 1, 1960; Revised Mar. 1, 1960. 31p. (WCAP–1391). Dep. CFSTI.

An analysis of the use of multilayer construction for the Saxton pressure vessel is discussed. Advantages of multilayer construction are listed. Problems in multilayer construction, such as thermal stresses and deviation from the ASME code, are analyzed. Specifications, fabrication procedures, and inspection techniques are summarized. Post experience with multilayer construction is considered. (M.L.S.)

17211 (DOCKET-50146–6) [SAXTON REACTOR PLANT.] Reactor Plant Operating Experience Report, April 1962–April 1963. (Saxton Nuclear Experimental Corp., Pa.). May 29, 1963. 23p. Dep. CFSTI.

Core loading and initial criticality of the Saxton Reactor are described. Operation from April 13, 1962, to April 30, 1963, is summarized; operating characteristics are tabulated; a comparison of calculated and measured operation parameters is listed. Calculated and measured core reactivity coefficients are compared. Open vessel tests, power operational tests, load-loss transient tests, and power coefficient measurements are summarized. (M.L.S.)

17212 (DOCKET-50146–7) SAFEGUARDS REPORT FOR THE SAXTON REACTOR PARTIAL PLUTONIUM CORE II. Supplement No. 1. (Saxton Nuclear Experimental Corp., Pa.). May 28, 1965. 36p. Dep. CFSTI.

The critical experiments for the Saxton Pu core are described; results of reactivity and power peaking results are tabulated. Operations experience with high-burnup UO_2 fuels is summarized. Possible hazards associated with the use of Pu fuel in-core are analyzed. The amount of Pu released to the containment from a maximum hypothetical accident is calculated. (M.L.S.)

17213 (DOCKET-50146–8) TECHNICAL SPECIFICATIONS, CHANGE NO. 24. (Saxton Nuclear Experimental Corp., Pa.). July 28, 1966. 12p. Dep. CFSTI.

Test fuel element assemblies for the Saxton Reactor are described; the test assemblies are for checking in-pile performance of Zircaloy-4 and stainless clad rods, and to determine effects of radio-induced stress relaxation and sub-standard weld features. Safety aspects are considered. (M.L.S.)

17214 (DOCKET-50146–9) TECHNICAL SPECIFICATIONS, CHANGE NO. 23. (Saxton Nuclear Experimental Corp., Pa.). Aug. 8, 1966. 4p. Dep. CFSTI.

USAEC approval of a request for a change in Technical Specifications for the Saxton Reactor is included. The change pertains to test fuel elements to be inserted into the reactor; the test elements are described briefly. (M.L.S.)

17215 (DOCKET-50146–12) SAFEGUARDS REPORT FOR THE SAXTON REACTOR OPERATING AT 35 MWt. ([Saxton Nuclear Experimental Corp., Pa.]). Dec. 1966. 69p. Dep. CFSTI.

A safety analysis of escalation of the power level of the Saxton Reactor to 35 MWt is included. Plant modifications are described; nuclear and thermal and hydraulic characteristics at 35 MWt are evaluated. Fuel element materials are discussed. Effects of reactivity and mechanical incidents are analyzed; the hypothetical accident is considered. Instrumentation modifications are described. Westinghouse experience with high power level fuel rods, as of 1966, is detailed. (M.L.S.)

17216 (DOCKET-50146–13) SAXTON REACTOR: TECHNICAL SPECIFICATIONS CHANGE NO. 25. POWER UPRATING TO 35 MWt. (Saxton Nuclear Experimental Corp., Pa.). Jan. 18, 1967. 36p. Dep. CFSTI.

The Technical Specifications change for increase of the Saxton Reactor power level to 35 MWt is included. The test fuel assemblies are described; non-fuel test capsules are discussed briefly. The Division of Reactor Licensing's safety evaluation of the change is included. (M.L.S.)

17217 (DOCKET-50146–15) TECHNICAL SPECIFICATIONS, CHANGE NO. 26. (Saxton Nuclear Experimental Corp., Pa.). Apr. 18, 1967. 4p. Dep. CFSTI.

The change to the Technical Specifications for the Saxton Reactor relating to the pressure relief valve settings in the supercritical loop is included. Values for valve settings are tabulated. (M.L.S.)

17218 (DOCKET-50146–16) SAXTON REACTOR: ACRS REPORT. (Saxton Nuclear Experimental Corp., Pa.). July 19, 1965. 2p. Dep. CFSTI.

The complete ACRS report on the use of a partial Pu core in the Saxton Reactor is included. Previous ACRS findings on other aspects of Saxton are referenced. (M.L.S.)

17219 (DOCKET-50146-17) TECHNICAL SPECIFICATIONS, CHANGE NO. 27. (Saxton Nuclear Experimental Corp., Pa.). Aug. 3, 1967. 10p. Dep. CFSTI.

The Technical Specifications change for insertion of an instrumented subassembly into the Saxton Reactor core is included. The subassembly is described; its use for observing effects of coolant pH change on fuel center temperatures and on heat transfer between instrumented fuel rods and coolant is discussed. The Division of Reactor Licensing's safety evaluation is included. (M.L.S.)

17220 (DOCKET-50146-18) TECHNICAL SPECIFICATIONS, CHANGE NO. 28. (Saxton Nuclear Experimental Corp., Pa.). Aug. 28, 1967. 14p. Dep. CFSTI.

The Technical Specifications change to allow insertion of fuel elements containing burnable poisons into the Saxton Reactor core is included. The rods containing the burnable poisons are described; mechanical performance and in-pile testing of the rods are discussed. The safety evaluation by the Division of Reactor Licensing is included. (M.L.S.)

17221 (DOCKET-50146-19) TECHNICAL SPECIFICATIONS, CHANGE NO. 29. (Saxton Nuclear Experimental Corp., Pa.). Aug. 31, 1967. 7p. Dep. CFSTI.

The Technical Specifications change allowing insertion of new pressurized fuel rod assemblies into the Saxton Reactor core is included. The pressurized Zircaloy-4 clad fuel rods, to be used for irradiation tests, are described. The Division of Reactor Licensing safety evaluation is included, also. (M.L.S.)

17222 (DOCKET-50146-20) TECHNICAL SPECIFICATIONS, CHANGE NO. 27, AMENDMENT 1. (Saxton Nuclear Experimental Corp., Pa.). Sept. 6, 1967. 6p. Dep. CFSTI.

Information pertaining to the coolant pH effects studies on instrumented fuel assemblies in the Saxton Reactor is presented. pH range and rate of change of pH are given. The performance of pH tests and related reactor operating conditions are considered. (M.L.S.)

17223 (DOCKET-50146-21) TECHNICAL SPECIFICATIONS, CHANGE NO. 13. (Saxton Nuclear Experimental Corp., Pa.). Sept. 29, 1967. 7p. Dep. CFSTI.

The Technical Specification change allowing a larger reactivity oscillator to be used in the Saxton Reactor core is included. The oscillator is described; safety aspects are considered. (M.L.S.)

17224 (DOCKET-50146-24) SAXTON REACTOR: CHANGE NO. 14. (Saxton Nuclear Experimental Corp., Pa.). Oct. 10, 1967. 10p. Dep. CFSTI.

Design changes to improve operational reliability of the Saxton Reactor supercritical loop are listed. A process flow diagram is included for the loop. (M.L.S.)

17225 (DOCKET-50146-25) TECHNICAL SPECIFICATIONS, CHANGE NO. 25, AMENDMENT 2. (Saxton Nuclear Experimental Corp., Pa.). Oct. 10, 1967. 8p. Dep. CFSTI.

Modifications in the variable frequency motor-generator set for the Saxton Reactor are described. Schematics of the reactor trip circuits are shown; an elementary diagram of the variable frequency motor-generator set is included. (M.L.S.)

17226 (DOCKET-50146-28) TECHNICAL SPECIFICATIONS, CHANGE NO. 25, AMENDMENT 3. (Saxton Nuclear Experimental Corp., Pa.). Nov. 21, 1967. 4p. Dep. CFSTI.

Testing of anti-simmer devices for the Saxton Reactor safety valves is described; a trip circuit schematic is included. (M.L.S.)

17227 (DOCKET-50146-30) TECHNICAL SPECIFICATIONS, CHANGE NO. 30. (Saxton Nuclear Experimental Corp., Pa.). Feb. 2, 1968. 5p. Dep. CFSTI.

A request for change in Technical Specifications for the Saxton Reactor is given. The change will allow accumulation of more in-pile creep data on Zircaloy-4 cladding at high pressures and operating temperatures. The test fuel element assemblies are described. (M.L.S.)

17228 (DOCKET-50146-31) SAXTON REACTOR: SAFEGUARDS REPORT ON SUPERCRITICAL TECHNOLOGY PROGRAM (REVISION). (Saxton Nuclear Experimental Corp., Pa.). Feb. 9, 1968. 25p. Dep. CFSTI.

The supercritical loop for the Saxton Reactor is described. The cooling system is described; the location of pressure relief valves and their actuation is discussed. Instrumentation and control systems for the loop are described. Loop startup, operation, and emergency procedures are given. (M.L.S.)

17229 (DOCKET-50146-32) SAXTON REACTOR: OPERATING LICENSE DPR-4, AMENDMENT 3. (Saxton Nuclear Experimental Corp., Pa.). Mar. 21, 1968. 11p. Dep. CFSTI.

The authorization for operation of the Saxton Reactor at 35 MWt is included with the Technical Specifications change reflecting this authorization. Operating conditions and test fuel element descriptions for this power level are listed. (M.L.S.)

17230 (DOCKET-50146-34) TECHNICAL SPECIFICATIONS, CHANGE NO. 31, AMENDMENT 1. (Saxton Nuclear Experimental Corp., Pa.). Apr. 19, 1968. 3p. Dep. CFSTI.

Revised design parameters for Saxton Reactor test fuel assemblies are given. New hot channel factors are included. (M.L.S.)

17231 (DOCKET-50231-27) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Facility Description and Safety Analysis Report, Amendment 28, Suppl. 23. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Feb. 20, 1969. 19p. Dep. CFSTI.

Modifications made to the cooling system of the Southwest Experimental Fast Oxide Reactor are described. Vacuum breaker modifications are given; isolation of the primary drain tank from the primary cooling system is discussed. Methods for protecting equipment and components which are required to investigate coolant loss effects are described; provisions to be used are tabulated. Revised pages to the PSAR are included. (M.L.S.)

17232 (IDO-17282) PARET: A PROGRAM FOR THE ANALYSIS OF REACTOR TRANSIENTS. Obenchain, C. F. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Jan. 1969. Contract AT(10-1)-205. 135p. Dep. CFSTI.

PARET is a digital computer program designed for use in predicting the course and consequences of nondestructive reactivity accidents in small reactor cores. It is basically a coupled neutronics-hydrodynamics-heat transfer code employing point kinetics, one-dimensional hydrodynamics, and one-dimensional heat transfer. PARET has been shown to give consistently good agreement (10 to 30%) with experiment over a wide range of initial conditions for a slightly enriched oxide core. Less extensive comparisons with data for a highly enriched plate core indicate 20 to 40% agreement with experiment. The code was written in machine language for the IBM-7040 but is being converted to FORTRAN-IV. A detailed description of PARET, including both the basic theory and its application in the program calculations, as well as instructions pertaining to the general use of the program is presented. 41 references. (auth)

17233 (ORNL-NSIC-58) INDEXED BIBLIOGRAPHY OF CURRENT NUCLEAR SAFETY LITERATURE-17. (Oak Ridge National Lab., Tenn.). Feb. 1969. Contract W-7405-eng-26. 269p. Dep. CFSTI.

Bibliographic information on nuclear safety is classified according to the following categories: General Safety Criteria; Siting of Nuclear Facilities; Transportation and Handling of Radioactive Materials; Aerospace Safety; Accident Analysis; Reactor Transients, Kinetics, and Stability; Fission Product Release, Transport, and Removal; Sources of Energy Release Under Accident Conditions; Nuclear Instrumentation, Control, and Safety Systems; Electrical Power Systems; Containment of Nuclear Facilities; Plant Safety Features; Radiochemical Plant Safety; Radionuclide Release and Movement in the Environment; Environmental Surveys, Monitoring and Radiation Exposure of Man; Meteorological Considerations; Operational Safety and Experience; and Safety Analysis and Design Reports. (D.C.C.)

17234 (ORNL-TM-2388) FISSION PRODUCT RELEASE FROM AN OVERHEATED HTGR FUEL (ORR POOLSIDE CAPSULE 06-11). Freid, S. H.; de Nordwall, H. J.; Cuneo, D. R.; Conlin, J. A.; Segaser, C. L.; Long, E. L. Jr. (Oak Ridge National Lab., Tenn.). Feb. 1969. Contract W-7405-eng-26. 39p. Dep. CFSTI.

The ORR poolside capsule experiment was designed to measure and characterize the release of mobile fission products from HTGR fuel during a simulated accident that would result in a temperature rise of the fuel at power. A "standard" fuel, in the form of UC_2 particles in a bonded matrix, was supplied by General Atomic and was used for this and other Nuclear Safety Program studies to facilitate comparison of results. The capsule, 06-11, operated with a fuel-graphite interface temperature of 1050°C and a corresponding central fuel temperature of 1220°C for 23 days when an internal leak developed in the primary containment of the capsule. It was necessary to reposition the capsule so that the power was about 34% of normal. Prior to capsule removal, an accident simulation was made by returning the capsule temperatures to the initial conditions 32 hr before the reactor shutdown. The

capsule remained in this position for 23 hours, then the temperatures were raised to the planned accident simulation; 1450°C in the graphite-fuel interface, 1720°C central fuel temperature, by advancing the capsule further toward the reactor. These conditions were held for 9 hours until the reactor shutdown. The bonded fuel showed no sign of damage. Fission product analysis of the fuel capsule components and fission product traps showed that, with the exception of iodine and ruthenium, essentially all of the nongaseous fission products were retained in the fuel. Not all of the ^{131}I and ^{103}Ru calculated to be present was found in the analysis of the fuel. However, no significant amounts of these isotopes were found elsewhere. (auth)

17235 (ORNL-TM-2479) ORNL NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROGRAM BIMONTHLY REPORT FOR NOVEMBER-DECEMBER 1968. Cottrell, Wm. B. (Oak Ridge National Lab., Tenn.). Mar. 1969. Contract W-7405-eng-26. 174p. Dep. CFSTI.

ALUMINUM ALLOYS AND SYSTEMS—corrosion by base-borate solutions of, effects of solution and spray on
CESIUM—removal by NSPP spray system of, effectiveness of Run 55 to 57
COPPER ALLOYS AND SYSTEMS—corrosion by base-borate solutions of, effects of solution and spray on
DATA RECORDING SYSTEMS—operations of Nuclear Safety Information Center during November and December 1968
FISSION PRODUCTS—distribution of aerosol, analysis of LOFT-condition fuel element failure
—size of aerosol, effects of age, humidity, and time on LOFT-condition
GRAPHITE—corrosion by steam of, effects of concentration on
KRYPTON ISOTOPES—removal from air by methyl-phenyl silicone rubber membranes
MEMBRANE FILTERS—effectiveness of krypton and xenon removal from air by methyl-phenyl silicone rubber
METHANE, IODO—removal by base-borate–thiosulfate spray solutions, effects of time and temperature on
—stability of, effects of temperature on
NEUTRONS, FAST—effects on mechanical properties of HSST steel plates
NUCLEAR SAFETY PILOT PLANT—spray effectiveness for cesium and uranium particle removal in Run 55 to 57
REACTOR FUEL ELEMENTS—failure of, analysis of fission product aerosol distributions in LOFT-condition
REACTOR SAFETY—research and development program during November and December 1968, analysis of ORNL
REACTORS, GAS-COOLED—graphite burnoff in high-temperature, effects of steam concentration on
REACTORS, HIGH-TEMPERATURE—graphite burnoff in gas-cooled, effects of steam concentration on
SHIELDED CONTAINERS—performance of Foamglas Shipping Container, testing of
STEEL—mechanical properties of plate-shaped HSST, effects of thickness on
—radiation effects on mechanical properties of HSST, fast neutron
URANIUM—removal by NSPP spray system of, effectiveness of Run 55 to 57
XENON ISOTOPES—removal from air by methyl-phenyl silicone rubber membranes
ZIRCALOY—mechanical properties of, measurement of high-temperature (D.C.C.)

17236 (SNE-51) AN APPRAISAL OF THE POTENTIAL HAZARD OF INDUSTRIAL SABOTAGE IN NUCLEAR POWER PLANTS. McCullough, C. Rogers; Turner, Stanley E.; Lyerly, Ray L. (Southern Nuclear Engineering, Inc., Dunedin, Fla.). July 1968. Contract AT(40-1)-3551. 48p. Dep. CFSTI.

A review of the potential hazard of industrial sabotage in nuclear power plants to the health and safety of the general public is presented. The vulnerability of nuclear power plants to acts of industrial sabotage is examined, the likelihood that such acts may adversely affect public safety is assessed, and desirable additional preventive measures or safeguard features are recommended for use by the regulatory divisions of the U. S. Atomic Energy Commission. 34 references. (H.D.R.)

17237 IMPROVEMENTS RELATING TO THE DETECTION OF LEAKS. Sinclair, Vivian Milby; Phillips, John Leslie (to United Kingdom Atomic Energy Authority). British Patent 1,143,878. Feb. 26, 1969. Filed Mar. 15, 1967.

A method of leak detection is described with particular reference to the detection of leaks in sealed containers subject to neutron irradiation in an environment of molten alkali metal, such as in liquid metal cooled reactors. The method does not rely on the detection of fission products in the sampled coolant, but employs an implanted inactive substance which is soluble in the alkali metal. Gold is the recommended substance, included adjacent to the inner surfaces of the container walls. The alkali metal is periodically sampled and tests made for the presence of ^{198}Au, which has a half-life such as to afford a leak detection technique of such sensitivity that further irradiation in an auxiliary neutron source is unnecessary. The gold is readily separable from the alkali metal by distillation; and from fission products, corrosion products, and other major impurities by solvent extraction, followed by precipitation with hydroquinone. The sealed container may include an internal graphite body, with the gold in the form of wire around this body, or as a continuous interlayer. (UK)

Power Conversion Systems

17238 (EURAEC-2048) STUDIES ON CYCLONES FOR STEAM SEPARATION IN BOILING-WATER REACTORS. Annual Report, 1967. Special Report No. 2. (Allgemeine Elektricitaets-Gesellschaft, Frankfurt am Main (West Germany). Kernenergieanlagen). May 10, 1968. Contract 083-66-1-TEED. 68p. (EUR-3992). Dep. CFSTI.

Work performed under United States–Euratom Joint Research and Development Program.

The development of a steam separator consisting of downflow cyclones for use in large reactors of the direct-cycle boiling-water type is described on the basis of a 600 MW(e) BWR. The experimental investigations with air–water mixtures into the problem of mixture distribution to cyclones in different positions in relation to the core are presented. The most suitable solution is a guide sheet arrangement, whereby each of the three concentric sets of cyclones has its own inlet channel. Each of these three concentric guide channels begins about 2 m above the core and deflects the mixture to the cyclones in the downcomer space. The mixture distribution to the cyclones in the two inside sets was studied experimentally on a full-scale model, the flows of two parallel cyclones connected to a mixture plenum being determined. The comprehensive measurements also include simulation of the flow distribution at the core outlet. The use of data to derive optimized geometrical parameters for cyclones is described. (auth)

17239 (ORNL-tr-3013) USE OF CARBON DIOXIDE TURBINES FOR ADVANCED REACTORS. Maillet, E.; Raveau, M. Translated for Oak Ridge National Lab., Tenn., from IAEA Symposium on Advanced and Gas-Cooled High-Temperature Reactors, Juelich, 21–25 October 1968. 14p. (CONF-681008-8). Dep. CFSTI.

The development potential for CO_2 turbines and corresponding direct cycles in high-temperature gas-cooled reactors is examined. Cycle design and efficiency and single shaft turbine characteristics are discussed. (H.D.R.)

17240 HELIUM GAS TURBINE FOR NUCLEAR POWER PLANTS. Keller, C.; Schmidt, D. Escher Wyss News, 40: No. 3, 3-10(1967).

After a long period of development since the first proposals made by Ackeret and Keller, the closed-cycle gas turbine, as built by Escher Wyss and Gutehoffnungshütte, has reached operation maturity. The experience gained in many successful industrial plants now ensures further development on a sound basis and permits the working principle to be transferred to the field of nuclear energy. Used in conjunction with gas-cooled high-temperature reactors, the helium turbine is a power plant with a secure future. With the technical resources available today, it is possible to build not only small plants for military and space flight purposes, but also power plant units of 600 MWe and over. Nuclear power plants of this type are especially suitable for combined power-heat production. 10 ref. (auth)

17241 IMPROVEMENTS IN OR RELATING TO POWER GENERATING PLANT. Hooper, Alan Thomas (to United Kingdom Atomic Energy Authority). British Patent 1,143,873. Feb. 26, 1969. Filed Feb. 8, 1967.

A power generating plant is described in which a proportion of the power comes from a direct conversion MHD duct. Hot outlet gas from a gas cooled nuclear reactor is passed directly to an MHD duct, and the energy remaining in the gas at the duct outlet is shared between a gas turbine and a steam raising heat exchanger. A rotary circulator may be included, driven by the gas turbine and supplying hot gas to the reactor. The steam raising heat exchanger may also be heated by the turbine exhaust gas. Means may be provided by which the heating gas path in the heat exchanger closes the gas circuit between the rotary circulator and the gas turbine. (UK)

17242 NUCLEAR APPLICATION OF THE LOEFFLER POWER CYCLE. Boegh, P.; Lys, L. A.; Streeton, D. F.

(Swiss Federal Inst. for Reactor Research, Wuerenlingen). Energy Int., No. 3, 1-4(1967). (EIR-113).

The application of the Loeffler cycle to a 250 MW(e) heavy-water-moderated pressure-tube reactor design is studied. The cycle is shown to offer many operational, performance, and safety advantages, and the economic optimization of the plant shows it to be economically competitive. (H.D.R.)

Research and Test Reactors

Refer also to abstracts 16055, 16190–16192, 16210, 16469, and 16853.

17243 (AD-672891) REACTOR UTILIZATION IN SUPPORT OF RESEARCH AND TECHNOLOGY. Final Report. Strain, Charles V. (Naval Research Lab., Washington, D. C.). June 21, 1968. 24p. (NRL-6709). CFSTI.

The radiations generated in a nuclear reactor are useful not only in nuclear physics research but also in many nonnuclear fields of science and technology. A review of present and potential applications of the NRL 1-MW reactor is undertaken with the purpose of encouraging additional utilization of this facility. Neutron activation analysis, a technique capable of assaying very small amounts of many of the chemical elements, is widely used, with examples of its use ranging from the analysis of trace impurities in highly purified materials to law-enforcement purposes. The sensitivities of the neutron activation technique, expressed as the smallest measurable amount of each chemical element, are included. Other techniques discussed include the measurement of magnetic and crystallographic structure by neutron diffraction, inert and radioactive tracer techniques, the production and use of radioactive sources, radiation effects, and thermal-neutron radiography. (auth) (USGRDR)

17244 (AECL-3137) IN-LINE BORON ANALYZER FOR WR-1. Tuxworth, R. H.; Speedy, R. J.; Matsumoto, R. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). May 1968. 56p. Dep. CFSTI. CAN $1.50.

The reactivity of the WR-1 reactor is controlled by the addition of boron as HBO_2 to the heavy water moderator. A Technicon AutoAnalyzer system has been installed to measure, intermittently or continuously, the boron concentration by direct sampling from the moderator system. The AutoAnalyzer uses continuous flow measurement of the color intensity produced by reaction of borate with the reagent H-resorcinol. Details of the total installation and its operation and maintenance are given. 6 references. (auth)

17245 (BNWL-917) FAST FLUX TEST FACILITY QUARTERLY TECHNICAL REPORT, JULY-SEPTEMBER 1968. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec. 1968. Contract AT(45-1)-1830. 133p. Dep. CFSTI.

CRITICAL ASSEMBLIES — reactivity calculations for NPTR annular conical core concept
— fuel handling at NPTR, radiation dose levels from, (T)
— accident analysis in NPTF, fault tree outline for
FAST FLUX TEST FACILITY — design and development of, July-Sept. 1968
— loop pipes for, gamma intensity near closed sodium, (T)
— loop system for, reliability analysis of closed
— loops for, design and development of closed sodium
FAST TEST REACTOR — design and development of, July-Sept. 1968
— core concepts for, design evaluation of
— fuel assemblies for, instrumentation design for
— loop test specimen conceptual design for
— coolant loss transient analysis for primary pipe rupture in
— heating and ventilation system for, transient temperature response of
— fuel pins for, temperature field in cladding and coolant from asymmetrical cooling of
— fuel meltdown in, maximum energy release by expansion of fuel-sodium mixture following
— poison rods for, maximum temperatures in
— core for, critical measurements in ZPR-3 on simulated
— fuels for, development and testing of
— cooling system for, radioisotope transport and deposition in
— coolant for, cover gas and impurity interactions with sodium
— neutron flux instrumentation in, testing of low level
— coolant temperature sensors in, testing of in-pile
— core structural materials for, irradiation and environment effects on Type 304 stainless steel
REACTOR FUELS — development of FTR mixed-oxide, July-Sept. 1968
REACTOR SAFETY — analyses for FFTF and NPTF, July-Sept. 1968
STAINLESS STEEL — properties of Type 304, effects of FTR core environment on (H.D.R.)

17246 (BNWL-985) REACTOR PHYSICS QUARTERLY REPORT, OCTOBER-DECEMBER 1968. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 1969. Contract AT(45-1)-1830. 118p. Dep. CFSTI.

CRITICAL ASSEMBLIES — reactivity calculations for NPTR annular conical core concept
— fuel handling at NPTR, radiation dose levels from, (T)
CRITICALITY STUDIES — critical mass and buckling measurements in uranium oxide (UO_2)-plutonium oxide (PuO_2)-water lattices
— critical mass of plutonium nitrate ($Pu(NO_3)_4$) solutions in slab geometry, (E)
FAST FLUX TEST FACILITY — loop pipes for, gamma intensity near closed sodium, (T)
FAST TEST REACTOR — core for, critical measurements in ZPR-3 on simulated
— fuel elements for, design calculations for detection and location system for failed
NEUTRONS, THERMAL — flux dipping or peaking in particle size fission foils used in thermal fission rate density measurements, correction method for
PLUTONIUM NITRATES $Pu(NO_3)_4$ — critical mass of solutions of, in slab geometry, (E)
PLUTONIUM RECYCLE CRITICAL FACILITY — physics measurements in Batch Core fueled, theoretical analysis correlation with
PLUTONIUM RECYCLE TEST REACTOR — fuel burnup calculations for Batch Core in
RADIATION DETECTORS, FISSION FOIL — neutron flux dipping or peaking correction for particle size, for use in thermal fission rate density measurements
REACTIVITY — multiplication factors for three dimensional two-group diffusion code calculations, extrapolation method for effective
REACTOR FUEL ELEMENTS — testing of Phoenix plates following irradiation in MTR
— failure detection and location system for FTR, design calculations for
REACTORS, FAST — physics studies on, summary of Oct. to Dec. 1968
REACTORS, THERMAL — physics studies on, summary of Oct. to Dec. 1968
URANIUM ISOTOPES U-238 — neutron epithermal to thermal capture ratio measurements in uranium oxide (UO_2)-plutonium oxide (PuO_2)-water lattices (H.D.R.)

17247 (BNWL-SA-2192) PHYSICS ASPECTS OF THE PRTR BATCH CORE EXPERIMENT. Mannan, M. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 1, 1968. Contract AT(45-1)-1830. 25p. Dep. CFSTI.

The reactor physics programs for the utilization of Pu in thermal power reactors conducted at the Pacific Northwest Laboratories are reviewed. The Plutonium Recycle Test Reactor is described, and the critical and irradiation experiments conducted with the 55-element UO_2-PuO_2 batch core loading are analyzed. (H.D.R.)

17248 (CEA-R-3349) MEASUREMENT OF THE INITIAL CONVERSION RATIO IN AQUILON AND EDF 2 REACTORS. Bergeron, Jean; Le Baud, Pierre; Sautiez, Bernard (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Nov. 1968. 44p. (In French). Dep.

In natural uranium fueled reactors, it is important to know the initial conversion ratio, i.e. the ratio of ^{236}U absorption to ^{235}U destruction. The separation of absorption products from fission products is a difficult feature in the measurement of the conversion ratio. A physical method was chosen, the $\gamma\gamma$ coincidence technique, which uses the properties of the decay scheme of ^{239}Np and allows the Np activity to be separated from the fission product activity, with some corrections. Detectors of natural uranium are used. The accuracy obtained in the measurements is of the order of 2%. 11 references. (auth)

17249 (CEA-R-3564) PEGASE REACTOR LOOPS. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Nov. 1968. 115p. (In French). Dep.

The first 4 years operation, experimentation and maintenance of the gas loops built especially for the nuclear fuel testing reactor Pegase are described. The reasons for the technical modifications and the way in which they were carried out are also described. (auth)

17250 (IDO-17287) SPERT PROJECT. Quarterly Technical Report, January-March 1968. Taxelius, T. G. (ed.) (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Nov. 1968. Contract AT(10-1)-205. 94p. Dep. CFSTI.

REACTIVITY—calculation of prompt moderator heating feedback in SPERT 3 E-core, (T)
REACTOR FUEL ELEMENTS—inspection of SPERT 4 CDC Type 304 stainless steel-clad uranium oxide (UO_2) F-type
—failure testing of SPERT 4 CDC Type 304 stainless steel-clad uranium oxide (UO_2) pellet-type rod-shaped SPX
REACTOR SAFETY EXPERIMENTS—kinetics for SPERT 3 E-core, analysis of prompt moderator heating, (T)
—fuel elements for SPERT 4 CDC, inspection of Type 304 stainless steel-clad uranium oxide (UO_2) F-type
—fuel elements for SPERT 4 CDC, failure testing assemblies of Type 304 stainless steel-clad uranium oxide (UO_2) pellet-type rod-shaped SPX (D.C.C.)

17251 (IDO-17290) ULTRASONIC CHANNEL MEASURING SYSTEM. Arave, A. E. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Jan. 1969. Contract AT(10-1)-205. 9p. Dep. CFSTI.

An ultrasonic system to plot the thickness profile of a fuel element coolant channel was developed to measure the ETR and ATR fuel elements in a canal after being removed from the reactor. It has an accuracy of 0.5 mil, a resolution of 0.1 mil, and a range from 50 to 175 mils. The heart of the system is a probe holding two 8-MHz, 10-mil-thick lead zirconate titanate piezoelectric crystals. Distance between channel walls is obtained by measuring the time for an 8-MHz sound burst to travel between the crystals which are held next to the walls. The signal received by one crystal, transmitted from the other crystal, is used as a trigger for a time-to-analog converter that is connected to the "Y" axis of a recorder. Longitudinal distance in the channel is converted to an analog output to drive the "X" axis of the same recorder. (auth)

17252 (IDO-17291) FUEL ROD DEFORMATION IN THE SPERT III OXIDE E-CORE. Etz, W. H. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Jan. 1969. Contract AT(10-1)-205. 55p. Dep. CFSTI.

Fuel rod deformation in the form of ridging of the cladding and rod bowing was detected in the SPERT III E-core following kinetics testing initiated from an elevated initial system temperature (500°F). The tests and analyses that were conducted to determine the cause of the deformation and the possible effects on proposed future tests of the reactor core are described. The deformation was concluded to be a phenomenon that may be expected under the SPERT III operating conditions. The deformation is not expected to have significant effects on the kinetic behavior of the SPERT III E-core. 17 references. (auth)

17253 (IDO-17293) ULTRASONIC ANEMOMETER FOR MEASURING STEAM CONVECTION CURRENTS. Arave, A. E. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Jan. 1969. Contract AT(10-1)-205. 12p. Dep. CFSTI.

An ultrasonic anemometer has been developed to measure air–steam mixture convection currents in reactor containment shells for AEC reactor safety programs. This anemometer was built specifically for the Loss of Fluid Test, LOFT, at the National Reactor Testing Station, NRTS. The detector is developed for high humidity, 130°C environment but can be used for measuring flow in many other gas conditions. It has an analog output proportional to velocity and speed of sound which can be used in the ultrasonic anemometer equation to find velocity and speed of sound. (auth)

17254 (IDO-17294) SPERT PROJECT. Quarterly Technical Report, July-September 1968. Taxelius, T. G. (ed.) (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Feb. 1969. Contract AT(10-1)-205. 19p. Dep. CFSTI.

REACTOR FUEL ELEMENTS—design characteristics of SPERT 4 CDC Zircaloy 2-clad uranium oxide (UO_2) pellet-type rod-shaped SPX
—failure testing of SPERT 4 CDC Zircaloy 2-clad uranium oxide (UO_2) pellet-type rod-shaped SPX
REACTOR SAFETY EXPERIMENTS—fuel elements for SPERT 4 CDC, design characteristics of Zircaloy 2-clad uranium oxide (UO_2) pellet-type rod-shaped SPX
—fuel elements for SPERT 4 CDC, failure testing assemblies of Zircaloy 2-clad uranium oxide (UO_2) pellet-type rod-shaped SPX (D.C.C.)

17255 (RISO-147) BEAM FACILITY FOR NEUTRON HALF-LIFE MEASUREMENT AT THE RESEARCH ESTABLISHMENT, RISOE. Christensen, C. J.; Nielsen, A.; Bahnsen, A.; Brown, W. K.; Rustad, B. M. (Danish Atomic Energy Commission, Risoe. Research Establishment). Nov. 1967. 25p. Dep.

A beam facility has been constructed at the Risö DR 3 reactor for use in the measurement of the neutron half-life. The technical design considerations pertinent to the facility and the physical equipment used to obtain a well-collimated, low-background beam of thermal neutrons are described. (auth)(Denmark)

17256 MAIN CIVIL ENGINEERING, BOILERWORK, AND STRUCTURAL FRAMING PROBLEMS ENCOUNTERED IN CONSTRUCTION OF OSIRIS REACTOR. Baron, C.; Garnault, M. Ann. Inst. Tech. Batiment Trav. Publics, No. 230, 177-203(Feb. 1967). (In French).

The work involving concrete includes: the floor, consisting of two independent parts; the water unit and the shell; the sealed pressure-vessel with a cylinder 28 m high and 32 m in diameter resting on the floor surmounted by a spherical dome with an internal radius of 34 m; and the prefabricated facades of the buildings, offices and lobbies. The construction of the steelwork of the structure includes: lined tanks placed in all the demineralized water cavities; and miscellaneous structures such as cofferdams, sealed doors, locks, stairways, and hoppers. (UKAEA Info. Bull.)

17257 SOVIET RESEARCH REACTORS. Koptelov, Evgueni. Energ. Nucl. (Paris), 10: 428-9(Nov. 1968). (In French).

Brief descriptions of the various U.S.S.R. research reactors are presented. (D.C.C.)

17258 SELF-LIMITING POWER EXCURSION CHARACTERISTICS OF LIGHT WATER REACTOR. I. DOPPLER-LIMITED PULSE OPERATION TESTS ON HTR. Imai, Munemaro; Yamad, Shuji; Tagami, Takashi; Kato, Hidemasa (Hitachi Ltd., Kawasaki, Japan). J. Nucl. Sci. Technol. (Tokyo), 6: 69-74(Feb. 1969).

The Doppler limited power excursion characteristics of a light water reactor and the shutdown mechanism by scram were analyzed on the Hitachi Training Reactor (HTR). For the purpose of the pulse operation tests, modifications were applied to the HTR to provide pulsing capability; a pulse rod was added, together with a back up device for shutdown, and provision of three instrumented fuel assemblies, equipped with thermocouples; the Al-clad fuel rods were replaced by stainless steel clad rods. About 100 runs of pulse operation tests were performed in fullest security with reactivity insertions ranging up to 1.0% $\Delta k/k$, in which last case the peak power reached 38 MW, with a reactor period of 29 msec. (auth)

Rocket and Space Reactors

Refer also to abstract 15975.

17259 (N-68-31164) SNAP-8 POWER CONVERSION SYSTEM ASSESSMENT. Thur, George M. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). 1968. 14p. (NASA-TM-X-52464; CONF-680802-10). CFSTI.

From 3rd Annual Intersociety Energy Conversion Engineering Conference, Boulder, Colo.

Details are given on the SNAP-8 system, the original design philosophy, and the present status of SNAP-8. An assessment is made of major components comprising the power conversion system. In addition, an estimate of the growth potential of the power conversion system is made using present hardware and what might be expected if major hardware changes were made. (auth)(STAR)

17260 (N-68-33238) A SNAP-8 BREADBOARD SYSTEM: OPERATING EXPERIENCE. Hodgson, J. N.; Macosko, R. P. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Aug. 1968. 35p. (NASA-TM-X-61161; CONF-680802-7). CFSTI.

From 3rd Annual Intersociety Energy Conversion Engineering Conference, Boulder, Colo.

SNAP-8 is a 35 kW nuclear-electric space power system. The system operates on a mercury Rankine cycle using NaK (eutectic sodium-potassium mixture) as the heat-input and heat-rejection working fluids. The test program has evolved from an initial component test phase to testing of complete breadboard systems. Extensive testing has provided information on the relationships between components and the system. Data are presented showing the perturbations, and their consequences, inherent in a dynamic system. Cause and effect relative to boiling instability, system contamination, inventory control, testing mishaps, and transient operation are presented as observed during the test program. The breadboard approach to system testing and design has proven appropriate. A close simulation to flight-configuration testing has been accomplished while maintaining the design flexibility of a breadboard system. (auth)(STAR)

17261 (N-68-34087) PRELIMINARY STUDY OF A THERMIONIC REACTOR CORE COMPOSED OF SHORT-LENGTH EXTERNALLY FUELED DIODES. Yacobucci, Howard G. (Na-

tional Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Sept. 1968. 69p. (NASA-TN-D-4805). CFSTI.

The characteristics of a thermionic reactor-core concept, aimed at incorporation of the best features of several previously proposed concepts, are studied. Optimization of diode dimensions resulted in a reference design for a 211-kW electric core. The design, which employs electrical zoning to reduce the detrimental effect of radial thermal power variation, was analyzed for various electrical failures. Equations were derived for calculating internal resistance losses in diodes that have an electrical conductor in parallel with an electrode. (auth) (STAR)

17262 (N-68-35068) SNAP 8 ELECTRICAL GENERATING SYSTEM DEVELOPMENT PROGRAM. Semiannual Progress Report, January 1-June 30, 1966. (Aerojet-General Corp., Azusa, Calif.). Aug. 1966. Contract NAS5-417. 222p. (NASA-CR-72103). CFSTI.

SNAP-8 is a turboelectric, nuclear, space power conversion system using a mercury Rankine cycle. The system incorporates three liquid metal loops. NaK in a primary loop is heated in a reactor, and, in turn heats mercury in a heat exchanger. The Hg vapor, in the second loop, expands through a turbine; it is then condensed and pumped back through the boiler. A third loop, also containing NaK, transfers the heat from the Hg to a radiator where it is rejected to space. The fourth loop contains a polyphenyl ether that lubricates the bearings of the main rotating components and provides necessary cooling for the alternator, electric motors, and controls. The development progress of the power conversion system, including turbine-alternator assembly, pump-motor assemblies, boiler, condenser, and electrical controls, is discussed. (auth)(STAR)

Marine and Portable Power Reactors

17263 (AD-672890) NOTCH DUCTILITY AND TENSILE PROPERTY EVALUATION OF THE PM-2A REACTOR PRESSURE VESSEL. Interim Report. Serpan, Charles Z. Jr. (Naval Research Lab., Washington, D. C.). June 19, 1968. 23p. (NRL-6739). CFSTI.

Following the pressurization-to-failure testing of the PM-2A reactor pressure vessel, several sections of steel were removed from the vessel wall in a region adjacent to the artificial defect. Charpy V-notch and tension test specimens machined from one of these sections have been evaluated. An assessment of the stress, temperature, and flaw-size conditions for the PM-2A failure, as indexed by the irradiated-condition mechanical properties, indicates that the failure is in agreement with the generalized fracture analysis diagram. (auth) (USGRDR)

Reactor Theory

Refer also to abstracts 17065 and 17246.

17264 (BNWL-SA-2359) AEROSOL TRANSPORT IN A CONDENSING STREAM ENVIRONMENT. Status Report. Hales, J. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 20, 1969. Contract AT(45-1)-1830. 16p. (CONF-690203-1). Dep. CFSTI.

From 8th Meeting of the U. S.-Canadian Reactor Safety Committee, Oak Ridge, Tenn.

An examination of the fundamental processes influencing the formation and behavior of boundary layers in condensing-steam systems is described. The examination is particularly concerned with the transport of aerosol particles. (D.C.C.)

17265 (GA-9051) LATTICE PHYSICS STUDIES. Quarterly Progress Report for the Period Ending September 30, 1968. Trimble, G. D.; Neill, J. M.; Gozani, T.; Preskitt, C. A. (Gulf General Atomic, Inc., San Diego, Calif.). Oct. 21, 1968. Contract AT(04-3)-167. 25p. (EURAEC-2076). Dep. CFSTI.

Work performed under United States-Euratom Joint Research and Development Program.

ALUMINUM ALLOYS AND SYSTEMS—Al-Pu, fuel elements of, modification for use in lattice physics measurements of
GLOVE BOXES—design for use in neutron spectra measurements on plutonium-aluminum lattices
NEUTRONS, THERMAL—spectra measurements in water-plutonium-aluminum lattices at room temperature
PLUTONIUM ALLOYS AND SYSTEMS—Al-Pu, fuel elements of, modification for use in lattice physics measurements of
PLUTONIUM ISOTOPES Pu-239—neutron cross sections for, calculation of 0.001 to 9 eV
PLUTONIUM ISOTOPES Pu-240—neutron cross sections for, calculation of 0.001 to 9 eV
PRESSURE VESSELS—testing of small, for temperature-dependent measurements in plutonium-aluminum fueled lattices
REACTOR FUEL ELEMENTS—modification of plutonium-aluminum, for use in lattice physics measurements
REACTORS—physics measurements on water-plutonium-aluminum lattices (H.D.R.)

17266 (ITEF-600) WHEN CAN THE "SAMARIC DEATH" OF A HIGH-FLOW REACTOR BE AVOIDED? Zaritskaya, T. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskogo i Eksperimental'noi Fiziki). 1968. 16p. (In Russian). Dep.

The Pontryagin maximum principle is used to find the optimal shutdown and burning out of ^{149}Sm. (auth)

17267 (ORNL-TM-2381) DIRECT CRITICALITY SEARCH IN SOLUTION OF FINITE-DIFFERENCE EIGENVALUE PROBLEMS. Vondy, David Ray (Oak Ridge National Lab., Tenn.). Mar. 1969. Contract W-7405-eng-26. 184p. Dep. CFSTI.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

The system of finite-difference equations which couple the neutron flux values at discrete points in phase space was cast into the general eigenvalue problem for a steady-state condition. The feasibility of direct iteration toward a specified steady-state condition, "direct search," was demonstrated by computer calculations. A study was made of the equations and iterative behavior of calculations for the directed neutron flux in one-dimensional slab geometry with anisotropic scattering and multi-group treatment of the energy variable. Calculations were also performed using Carlson's S_n equations. Several problems encountered in analysis of a variety of nuclear reactor cores were solved by application of the direct search techniques to the formulation associated with the diffusion approximation to neutron transport. Comparison of the iterative behaviors of direct search and usual eigenvalue solutions indicates that only little additional effort is usually required for the former. Thus it is practical with effective iterative procedures to satisfy steady-state conditions directly. Considerable use of the direct search technique is expected in analysis of nuclear reactor cores. 60 references. (auth)

17268 (ORNL-TM-2421) DESIGN CURVES FOR BURNOUT HEAT FLUX IN FORCED-CONVECTION SUBCOOLED LIGHT-WATER SYSTEMS. Gambill, W. R. (Oak Ridge National Lab., Tenn.). Nov. 14, 1968. 31p. Dep. CFSTI.

Design (minimum) values of burnout heat flux for subcooled water systems are calculated. The calculated fluxes are not reduced with an arbitrary design factor; instead, each term is modified to coincide with the lower bound of available experimental data-i.e., established scatter limits are applied to each factor separately. Burnout fluxes are plotted for $10 < V < 100$ fps, $15 < P < 3000$ psia, $100 < \Delta t_{sub} < 400°F$, and channel equivalent diameters of 0.1 and 0.5 in. A simple method is described for estimating the ratio of burnout to incipient-boiling heat fluxes. The method is applied to the HFIR to indicate the dependence of the subject flux ratio on velocity, subcooling, and pressure. 11 references. (auth)

17269 (WASH-1125) PROGRESS IN REACTOR PHYSICS. Lowery, Virgil W.; Sakalosky, George P. (eds.) (Division of Reactor Development and Technology (AEC), Washington, D. C. Reactor Physics Branch). Jan. 1969. 162p. Dep. CFSTI.

Research in neutron thermalization, cross section measurements, basic shielding studies, experimental research on critical assemblies, nuclear data evaluation, reactor calculational methods development, fuel burnup studies, and neutron flux distribution investigations which are supported by the Division of Reactor Development and Technology are summarized. A general description of the scope of each individual task, of the recent work performed, and of work anticipated in the near future is presented. (H.D.R.)

17270 SLABS OF AN $1/\nu$ ABSORBER IN AN $1/E^{\mu}$ NEUTRON FLUX. Fritzsch, E. (Physikalischen Institut der Bergakademie, Freiberg, Ger.). Kernenergie, 11: 262-5(Oct. 1968). (In German).

Slabs of an $1/\nu$ absorber in an $1/E^{\mu}$ neutron flux with $0.5 < \mu < 1.5$ are considered. General solutions are given for the absorption rate per unit area in the case of a collimated beam of neutrons and in an isotropic flux. (auth)

17271 PROBLEM OF ENTROPY IN NUCLEAR PROCESSES WITH REGARD TO THE EXERGONIC EFFICIENCY OF NUCLEAR REACTORS. Swierzawski, Tadeusz; Tomeczek, Jerzy. Zesz. Nauk. Politech. Slaska, Energ., No. 123, 127-8(Nov. 1964). (In Polish).

The problem of entropy increase in a nuclear reactor is studied

with regard to the contributions made by individual phenomena to the total increment in entropy. Since the problem is extremely complicated, a number of simplifications and special assumptions are made without distorting the general nature of the phenomena. Numerical calculations for the experimental WWR-S reactor "Ewa" at the Institute of Nuclear Research in Swierk are used as a basis for estimating the exergonic efficiency of nuclear reactors powered by natural or enriched uranium. Two definitions are given for reactor efficiency: (1) exergonic efficiency in the use of nuclear fuel with consideration to the fact that it is impossible to "burn" all the fuel since a critical mass must be maintained in the reactor core; (2) effective exergonic efficiency with consideration to the possibility of continued "burning" of fissioned nuclides extracted from the reactor core. The results may be used for calculating reactor efficiency as a function of the type of fuel cycle. (JPRS)

17272 ANALOG COMPUTER FOR STUDYING THE KINETICS OF NUCLEAR REACTORS. Swierzawski, Tadeusz; Puszer, Andrzej. Zesz. Nauk. Politech. Slaska, Energ., No. 123, 123-5 (Nov. 1964). (In Polish).

The basic principles of an analog device for solving a system of differential equations describing the behavior of a nuclear reactor with respect to time are given. Systems of this type are difficult to solve, especially when the reactivity varies with time. The proposed device may be used for solving problems involving six groups of delayed neutrons, or may alternatively be programmed for a simplified equation with a single group of delayed neutrons. The proposed computer may be used in studying high-power reactors where the maximum neutron density in the core may reach 10^{15} n/cm^3. The voltage at the output of the operational amplifier is proportional to neutron density. This voltage has a range of 0-100 V. The full scale is used in six ranges for readings from 10^3 to 10^{15} n/cm^3. In addition to the operational amplifiers, the computer contains modulation circuits, a control unit, automatic scale adjustments, a recording unit and power supply. The computer has been used in a number of experiments involving subcritical and supercritical reactor conditions as well as for studying starting and stopping of chain reactions. (JPRS)

17273 SCATTERING MODELS FOR NEUTRON THERMALIZATION IN NUCLEAR REACTORS. Emendoerfer, D. (Univ., Stuttgart). Atomkernenergie, 14: 97-106(Mar.-Apr. 1969). (In German).

A survey is given on theory and calculation of slow neutron inelastic scattering by moderators. The following scattering models are discussed: water: Models by Nelkin, Haywood, Koppel-Young, McMurry-Russel; ZrH_2: Models by Rosenbluth-Nelkin, Young, Slaggie; and graphite: Models by Yoshimori-Kitano, Koppel-Young, Egelstaff. Modern codes like GASKET (with FLANGE), SLAB (with PIXSE) and SCAT may evaluate numerically or semi-analytically the scattering law and the scattering cross section from the frequency distribution. It is shown to what extent calculated properties of nuclear reactors will depend on details of the scattering model. 47 references. (auth)

17274 SPATIALLY DEPENDENT THERMAL NEUTRON SPECTRA IN SLAB AND CYLINDRICAL GEOMETRIES. Neill, J. M.; Young, J. C. (Gulf General Atomic Inc., San Diego, Calif.). Contract AT(04-3)-167. Nukleonik, 12: No. 1, 18-28 (Dec. 1968).

Time-of-flight measurements of thermal neutron spectra have been made as a function of position in slab and cylindrical systems having dimensions appropriate to reactor lattices. The measured data have been compared to theoretical predictions and a reasonably good agreement has been obtained. These techniques yield considerable differential information on the strongly position dependent flux and hence offer useful checks of the cross sections and calculational methods. There appears to be no major difficulty in extending these techniques to actual reactor lattices. 32 references. (auth)

17275 REACTIVITY MEASUREMENTS BY A NOISE TECHNIQUE IN A REACTOR WITH A PULSED NEUTRON SOURCE. Elmeshad, Y. (Alexandria Univ., Egypt). Nukleonik, 12: No. 1, 7-11(Dec. 1968).

A method which combines some aspects of the pulsed neutron source and noise techniques is proposed for determining the kinetic parameters in a subcritical nuclear system. The time-dependence of one of the statistical properties of neutron detection, namely, the detection zero probability, is determined in a reactor with repetitively pulsed neutron source. It is shown that by fitting the measured time-dependent zero probability to a theoretically derived formula, it is possible to determine the prompt decay constant and the reactivity in dollars. It is also shown that it is possible to determine some other kinetic parameters. The analysis takes advantage of the contribution of the delayed neutrons to the measured zero probability and treats it in a Garelis-Russell-likewise approach. 17 references. (auth)

17276 MONOENERGETIC INITIAL-VALUE TRANSPORT PROBLEM IN SLAB GEOMETRY. Gell, G.; Pucker, N. (Univ., Graz). Nukleonik, 12: No. 1, 38-44(Dec. 1968).

The time dependent, monoenergetic Boltzmann equation is treated by two different methods: eigenfunction expansion and linear extrapolation along characteristics. Thus it is possible to describe the whole time range from zero to infinity. Among others some results concerning the influence of the continuous time eigenvalues are obtained. 7 references. (auth)

17277 METHOD TO SOLVE MULTIGROUP P3 EQUATIONS IN CYLINDRICAL GEOMETRY. Matausek, M. V. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Nukleonik, 12: No. 1, 45-7 (Dec. 1968).

To determine the space-energy distribution of thermal neutrons in a reactor cell a combination of the spherical harmonics method and multigroup procedure has been chosen. In P-3 approximation and cylindrical geometry such a scheme implies the solution of an inhomogeneous system of six ordinary first order differential equations. The general solution of the corresponding homogeneous system is known in analytical form. The free term of the system can be approximated in order to find a particular solution, and thus the general solution, of the inhomogeneous system. The procedure has been applied to calculate thermal spectra in a number of different reactor cells. Some results are presented and discussed. 5 references. (auth)

17278 KINETIC BEHAVIOR AND REACTIVITY OF LOOSELY COUPLED FISSION ZONES. Kussmaul, Guenter (Kernforschungszentrums, Karlsruhe, Ger.). Nukleonik, 12: No. 1, 28-38 (Dec. 1968). (In German).

The kinetic behavior of two loosely coupled cores can be treated by coupled kinetics equations. Except for the prompt time behavior, the neutron transition time can be neglected. Assuming equal composition and prompt neutron generation time of the two cores, the equations are solved for the case of step reactivity perturbations. The roots of the resulting "inhour equation" are shown to split into two sets, each of which satisfies an inhour equation of a one-point reactor. This leads to two parameters ρ_1 and ρ_2; ρ_1 being the reactivity of the entire system and ρ_2 characterizing the change in the spatial distribution. Also the time behavior of each core is given by two terms. The first represents the response of a point reactor to the reactivity change of the entire system, while the second describes changes in the spatial distribution. By weighting the signals of two neutron detectors, point reactor methods can be used to evaluate the parameters ρ_1 and ρ_2. The theroetical model was used to evaluate the reactivity and coupling constants from rod drop and period measurements performed in the two-slab loading of the Argonaut Reactor Karlsruhe (ARK). Good agreement between experiments and theory was found. As expected, deviations from the model were observed in the ring loading. 29 references. (auth)

17279 APPLICATION OF THE VOLTERRA FUNCTIONAL SERIES TO THE SPACE-INDEPENDENT KINETICS OF HOMOGENEOUS REACTORS. Kielkiewicz, M. (Warsaw Technical Univ.). Nukleonika, 13: 1037-46(1968).

The Volterra functional series are applied to derive the approximate response of homogeneous reactors with a single negative temperature coefficient of reactivity and delayed neutrons to arbitrary reactivity variations. The region of stability under constantly acting reactivity disturbances is estimated. (D.C.C.)

Experimental Applications

17280 (BNWL-904) INTEGRAL TARGET FUEL IN A WATER COOLED GRAPHITE LATTICE: THEORY-EXPERIMENT CORRELATION. Bennett, C. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 31, 1968. Contract AT(45-1)-1830. 59p. Dep. CFSTI.

A complete multi-group S_n transport theory analysis and comparison with experiment was made for an integral target fuel in a water-cooled graphite lattice, including the investigation of the leakage effect on k_∞. Emphasis was placed on the magnitude, relative importance, and recommended improvements of errors in the theory-experiment comparisons due to either the models or methods used. The improved techniques give results that are in reasonably good agreement with most of the measured lattice parameters. (auth)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 16176, 16478, 16479, 16510, 16512–16515, 16519, 16521, and 16524.

17281 (CEA-R-3612) PROTECTION OF ZIRCONIUM AND ITS ALLOYS BY METALLIC COATINGS. Loriers, Henri; Lafon, Alain; Darras, Raymond; Baque, Pierre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Oct. 1968. 20p. (In French). Dep.

Metallic coatings to protect Zr and Zr-alloy fuel cladding at 600°C in a CO_2 environment were tested. Coatings of Al and Cu proved to be unsatisfactory. However, Cr and Mo coatings produced desired effectiveness and film adherence to the Zr. (D.C.C.)

17282 (ORNL-TM-2443) PROFIL: A ONE-DIMENSIONAL FORTRAN IV PROGRAM FOR COMPUTING STEADY-STATE TEMPERATURE DISTRIBUTIONS IN CYLINDRICAL CERAMIC FUELS. Cox, C. M.; Homan, F. J. (Oak Ridge National Lab., Tenn.). Mar. 1969. Contract W-7405-eng-26. 52p. Dep. CFSTI.

A computer program is presented for calculating the radial temperature profile of a cylindrical ceramic fuel pin. Starting at the fuel surface, the temperature rise across each increment is determined from the fission rate, gamma heating rate, density, and thermal conductivity of the material in the increment. The radial positions of columnar and equiaxed grain formation are determined from the nondensified fuel profile. The size of the central void is then calculated from the mass balance. Finally, a densified fuel temperature profile is calculated. Not considered in the calculations are cladding, thermal expansion, and fuel swelling. A FORTRAN 4 source program listing, input instructions, a glossary of variable names, and a sample problem are provided. (auth)

17283 (ORNL-TM-2444) THREE-DIMENSIONAL SCATTERED-LIGHT PHOTOELASTIC ANALYSIS OF AN AXISYMMETRIC EPOXY MODEL OF A PRESTRESSED CONCRETE REACTOR VESSEL. McAfee, W. J. (Oak Ridge National Lab., Tenn.). Feb. 1969. Contract W-7405-eng-26. 50p. Dep. CFSTI.

The results of a scattered-light photoelasticity analysis of a small axisymmetric epoxy model of a prestressed concrete reactor vessel are presented. The investigation reported is part of a broad model study program carried out at Oak Ridge National Laboratory to determine the suitability and accuracy of very small-scale mortar and epoxy models for investigating the elastic stress distributions and the cracking and ultimate failure modes of concrete vessels. The purpose of the photoelastic model study was to evaluate the suitability and accuracy of the scattered-light technique for determining the elastic stresses in small epoxy models of concrete vessels, or of components of such vessels. The scattered-light method is briefly reviewed, the experimental investigation is described, and the stress distributions determined from the photoelastic analysis are presented. The results are compared to the distributions predicted by an axisymmetric elastic finite-element analysis and with surface stresses obtained from a strain-gage analysis that was also carried out. In general the agreement between it is concluded that the scattered-light photoelasticity method is a reliable and reasonably accurate way of determining the three-dimensional elastic stress distributions in epoxy models of the type examined. (auth)

17284 ON THE APPLICATION OF THE PULSE-HEIGHT DISTRIBUTION OF SINGLE-ELECTRON PULSES AS THE REFERENCE DISTRIBUTION FOR STABILIZING A SINGLE-CHANNEL SCINTILLATION SPECTROMETER. I. Seifarth, H. (Institut fuer Elektronik, Dresden). Kernenergie, 11: 255-61(Oct. 1968). (In German).

After noting some principal remarks on the characteristic of a scintillation spectrometer and its stability, the applicability of an "internally" produced reference distribution for the control technique of stabilizing the spectrometer characteristic is discussed. Stability of the pulse-height distribution of single-electron pulses occurring as the dark-current pulses on the photomultiplier output has been obtained for selected specimens of M 12 FS 35 and M 12 FS 60 type photomultipliers at variation of scintillation rate by adequate choice of the electron-optical input system potentials. The principle of operation and the electronic design of a stabilized single-channel spectrometer using the pulse-height distribution of single-electron pulses as the reference distribution are described. Experimental results of the dynamic and steady-state behavior are given. The influence of the "discontinuous record" specific for this method of control, on statistical accuracy of counting and energetic resolution of the spectrometer is discussed. With a maximum control gain of $(V_r)_{max} \approx 100$ the control technique described here has, with nearly the same expenditure, at least the same efficiency as the control techniques known so far for single-channel spectrometers but utilizes the advantages of the "internally" generated reference distribution. (auth)

17285 ESTABLISHMENT OF THE BOUNDARY CONDITIONS, WHICH MUST BE FULFILLED IN THE TRANSITION REGION BETWEEN CIRCULAR PIPES CUTTING PERPENDICULARLY ONE ANOTHER FOR CALCULATING STRESS. Mai, W. (VEB Kernkraftwerksbau, Berlin). Kernenergie, 11: 252-5(Oct. 1968). (In German).

Boundary conditions are established, which must be fulfilled in the transition region of two statically loaded circular cylindrical shells cutting perpendicularly one another. (auth)

17286 BURN-OUT OF CADMIUM SHIELDS. Goerner, W. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 11: 249-52(Oct. 1968). (In German).

The burn-out of tubular shields consisting of Cd sheet has been investigated in a thermal neutron field. A relationship for calculating the lifetime of such a shielding is given. A Cd shield 0.4 mm thick and of 30 mm in diameter shielding a thermal flux of 10^{14} n cm^{-2} s^{-1} has, for example, a lifetime of 250 days of irradiation. It is shown that for "black" absorption of the thermal neutrons the lifetime of this shielding is dependent on the number of highly absorbing nuclei per unit area only, but not at all on their absorption cross-section. (auth)

17287 IMPROVEMENTS IN AND RELATING TO THE ACTUATING MEANS OF NUCLEAR REACTOR CONTROL RODS. Winders, Gordon Robert (to Babcock and Wilcox Co.). British Patent 1,143,752. Feb. 26, 1969. Priority date Aug. 19, 1965, United States.

REACTOR CONTROL ELEMENTS—driver for rod-type, description of latch-retained spring-loaded dual-position hydraulic

REACTORS—control rod drives for, description of latch-retained spring-loaded dual-position hydraulic (D.C.C.)

17288 NUCLEAR FUEL HOIST. Bunger, Robert C. (to Combustion Engineering Inc.). U. S. Patent 3,421,635. Jan. 14, 1969. Filed Dec. 29, 1966.

A nuclear fuel hoist is described having an extendable and rotatable fuel grabbing means and guiding or keying means for preventing relative rotation between the grabbing means and the fuel during the hoisting operation to prevent accidental release of the fuel. (Offic. Gaz.)

17289 NUCLEAR FUEL HANDLING SYSTEM. MacKay, Ian Norton (to General Electric Co., Ltd.). U. S. Patent 3,428,523. Feb. 18, 1969. Filed Nov. 16, 1966.

A system to provide on-load refueling of a reactor is described. The system consists of a sealed mobile magazine which attaches to the bottom of the downward-flow vertical reactor free-standing fuel elements. The magazine contains the replacement fuel elements. (D.C.C.)

17290 NUCLEAR REACTOR SYSTEM WITH FISSION GAS REMOVAL. Fortescue, P. (to United States Atomic Energy Commission). U. S. Patent 3,432,388. Mar. 11, 1969.

A fluid-cooled nuclear reactor is described having a venting system for relieving pressure inside clad fuel pins. A passageway network interconnects the interiors of otherwise sealed clad fuel pins in different fuel elements, and gas is admitted to initially bring the internal pressure to within a given increment of the coolant pressure at startup. When fission products cause the internal pressure to increase, gas in vented to storage vessels to maintain the internal pressure proportional to the coolant pressure. (AEC)

17291 DETERMINATION OF FISSION GAS RELEASE FROM COATED PARTICLES BY MEANS OF ON-LINE GAMMA SPECTROMETRY. Knoth, J.; Sandrock, F.; Schwenke, H. Atomkernenergie, 14: 94-6(Mar.-Apr. 1969).

A method is proposed for measuring automatically the release of volatile fission products from coated particles in the course of irradiation of instrumented capsules placed in an operating reactor. The irradiation data relevant to the fission products release will be collected simultaneously by an on-line computer and will be used for the control of data collection and for assigning measured release rates to the recorded irradiation data for the purpose of clarifying the mechanism of release of fission products from coated particles. (auth)

17292 GAPS IN A CONCRETE RADIATION SHIELD. Lettnin, H. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Hamburg); Seboek, F. Atomkernenergie, 14: 125-8(Mar.-Apr. 1969). (In German).

The effects of gaps in a concrete radiation shield are analyzed. Basing the investigations on the geometrical arrangement of the secondary shield on board the "Otto Hahn" thick concrete slabs against the longitudinal and transverse bulkheads are used. Source of the γ-radiation is the containment vessel which in case of a MCA will be filled with fission gases. For different space points coefficients are computed showing the relation between a solid

concrete well and a well with gaps with variations of concrete thickness, size and angle of gaps. It will be shown that the detrimental effect of gaps should not be overestimated as it can often be controlled by simple design measures. (auth)

17293 FUEL ASSEMBLY FOR A NUCLEAR REACTOR. Dean, R. A.; McCabe, E. A. Jr. (to United States Atomic Energy Commission). U. S. Patent 3,432,390. Mar. 11, 1969.

Flow alteration means to substantially eliminate coolant flow redistribution between adjacent fuel assemblies and to mix the exiting coolant while effecting a low coolant pressure drop is described. A fixed flow impeding device upon which the coolant impinges is placed above the fuel element cluster below the upper core plate. (AEC)

17294 IMPROVEMENTS IN OR RELATING TO THERMOCOUPLE-CARRYING NUCLEAR REACTOR FUEL ELEMENTS. Guneratne, P. P. (to United Kingdom Atomic Energy Authority). British Patent 1,143,108. Feb. 19, 1969. Filed May 2, 1966.

The fuel element described comprises a nuclear fuel member enclosed in a protective sheath. The sheath has a collar extending radially inwards from its inner periphery to form an enlarged portion through which passes a straight open-ended passageway. A blind-ended passageway leads into the enlarged portion from the exterior surface of the sheath and lies diametrically opposite and parallel to the open-ended passageway. An external groove connects the passageways, and the thermocouple cable terminates in a hot junction within the blind-ended passageway, extending from the latter along the external groove and through the open-ended passageway. The heat transfer surface of the fuel element sheath is not disturbed, nor need the coolant flow pattern over the sheath upset. Larger thermocouple cables may be used than if the thermocouple junction is just brazed to the fuel element sheath. (UK)

GENERAL

17295 (AEC-tr-6818) NUKLEONIKA. Translation of Nukleonika, 12: 589-868(1967). 269p. Dep. CFSTI.

17296 (AEC-tr-6819) NUKLEONIKA. Translation of Nukleonika, 12: 869-976(1967). 101p. Dep. CFSTI.

17297 (AERE-R-5629) FORTRAN PROGRAMME FOR THE NUMERICAL SOLUTION OF PARABOLIC PARTIAL DIFFERENTIAL EQUATIONS. Klaschka, J. T. (Atomic Energy Research Establishment, Harwell (England)). Oct. 1968. 16p. Dep. CFSTI. UK 3s.

A Fortran IV computer program for the numerical solution of parabolic partial differential equations in one time and two space coordinates is described. The program has been implemented on the IBM system 360/65 computer at A.E.R.E. Harwell. The program comprises a small main routine, which calls the major subroutine FDTD3. This major subroutine solves the equations and requires two minor subroutines FORMSB which contains the equations in finite difference form and UPDATE, which allow the modification of equation parameters during the computation. The program is designed to handle both linear and nonlinear equations, with uniform and nonuniform initial conditions and derivative or fixed boundary conditions. Tape and disk, reading and writing facilities are written into the program. (auth)

17298 (BNWL-913) SCATTERING OF LONG OCEAN WAVES. Zwibel, H. S.; Gibbs, A. G. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 1969. Contract AT(45-1)-1830. 18p. Dep. CFSTI.

The differential equation describing the scattering of long ocean waves by a localized scatterer such as a seamount is transformed to an integral equation of the form arising in quantum mechanical scattering theory. The application of various approximation techniques developed in quantum mechanics is discussed and, as an example, an analytical expression is obtained for the first Born approximation to the wave scattered by a cylindrically symmetric seamount of arbitrary profile. The range of validity of this approximation is determined. (auth)

17299 (EGG-1183-2178) LASER PROPAGATION EFFECTS OVER A HALF-MILE PATH. Technical Report Number S-416-R. Plake, W. C.; Walsh, G. E. (EG and G, Inc., Santa Barbara, Calif.). Mar. 1968. Contract AT(29-1)-1183. 25p. Dep. CFSTI.

A study was made to experimentally determine atmospheric effects on propagation of a collimated laser beam over a half-mile path. Data were taken to define movement of the centroid of the received beam, measure changes in envelope size of the received beam, changes in angle of arrival, and changes in the received power of the total beam. The measurement system is described, and a brief analysis of the experimental method used in the study which was performed at the Nevada Test Site is given. The data collected during the study are summarized, and the results are discussed. (auth)

17300 (K-1722) UNION CARBIDE DUAL-HEAD INSPECTION POST PROCESSOR. Schellinger, W. V. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). Feb. 19, 1969. Contract W-7405-eng-26. 176p. Dep. CFSTI.

The Union Carbide Dual-Head Inspection Post Processor is a special purpose post processor that produces command tapes and/or listings for numerically controlled inspection machines with more than one inspection gage. It has a foundation which allows similar types of inspection machines to be added with a minimum amount of effort. (auth)

17301 (MLM-1580) A STATISTICAL EVALUATION OF POWDER CHARACTERISTICS MEASURED WITH THREE SYSTEMS. Grandillo, A. D. (Mound Lab., Miamisburg, Ohio). Feb. 28, 1969. Contract AT(33-1)-Gen-53. 27p. Dep. CFSTI.

Particle sizes of powder samples were statistically analyzed using data from three systems, a Coulter Counter, a sedimentation balance (Sedibal), and a Fisher Sub-Sieve Sizer. It was concluded that the particle size distributions obtained from the Coulter Counter and Sedibal are log normal. It was also concluded that the weight fraction distribution is not a probability distribution, but is a weight fraction-in diameter relationship, which is functionally related to the probability function defining the number-fraction data. A statistical model was derived which showed that the average specific surface is a function of the parameters of the number fraction distribution. (auth)

17302 (NIRS-7, pp 11-18) CHEMISTRY. (National Inst. of Radiological Sciences, Chiba (Japan)).

Research progress is reported on: adsorption of cesium on copper ferrocyanide and potassium copper ferrocyanide, adsorption of radiostrontium on calcium phosphate anion exchange resin, autoxidation of 2-ethoxyindole and 2-ethylthioindoles, NMR spectra of oxindoles and 2-indolinethiones, transquanylation of AET and APT, Schiff base formation from pyridoxal in methanol, volatility of ^{210}Po in airborne dusts, preparation of mevalomic-3', 4-D and 3', 4-T acid, and a premix burner with heated mixing chamber in atomic absorption spectrophotometry. (M.C.G.)

17303 (NLCO-1034) FEASIBILITY OF USING A LASER AS AN ILLUMINATING SOURCE FOR OPTICAL MICROSCOPY. Schaich, E. L. (National Lead Co. of Ohio, Cincinnati). Sept. 25, 1968. Contract AT(30-1)-1156. 13p. (CONF-681044-1). Dep. CFSTI.

From 18th Annual National Lead Company Analytical and Physical Testing Symposium, Hightstown, N. J.

A helium–neon laser was used as the light source in a Bausch and Lomb metallograph in an attempt to extend the useful magnification range of the optical microscope. Results indicate that image contrast is greatly increased but resolution is essentially unchanged. (W.H.K.)

17304 (ORNL-4281) TABLES OF THE FABRY FACTORS G AND V, AND OF MAGNETIC FIELD HOMOGENEITY, FOR THICK CYLINDRICAL COILS. Garrett, Milan Wayne (Oak Ridge National Lab., Tenn.). Feb. 1969. Contract W-7405-eng-26. 58p. Dep. CFSTI.

Tables are presented which describe the properties of cylindrical coils with two distributions of current density: A, uniform, and B (Bitter type), inversely proportional to the cylindrical radius. The insertion (A), identifies a statement or table description that does not apply to Bitter coils. In the first section, the Fabry power efficiency factor G is tabulated for some 3000 coils of each type and the square root (V*) of the Fabry volume factor for 1000 coils, with the customary parameters α and β as arguments. The product GV* is the field intensity F at the center of the coil (A). F is tabulated as a function of (α,β), and α as a function of $(F,\beta)(A)$. There is also a table of 180 minimum volume coils (A), which have the lowest value of V* that is consistent with a given value of G. In the second section, geometrical limits of field homogeneity, for a given percentage error ϵ, are defined in polar coordinates by a set of radii $r(\alpha,\beta,\epsilon,\theta)$. The absolute error at (r,θ) is defined as the magnitude of the vector difference of the local field and the field B_0 at the central origin. Therefore $\epsilon \equiv 100|B(r,\theta) - B_0|/|B_0|$. This severe definition takes into account both the axial and the radial component of inhomogeneity. Axial error limits $z_\epsilon(\alpha,\beta)$ are tabulated directly for ϵ = 1.0, 0.2, 0.5, 2.5, 5.0, 7.5, and 10.0, with 1200 entries for each error magnitude. With the aid of a standard (r,θ) error curve and tables of corrections, the general error radius can be estimated within about ±3% within the following limits: α, 1 to 10; β, 0 to 10; ϵ, 0 to 10; θ, 0 to 90°. The third section is reprinted from an earlier report. It is a table (A) of the factor 1/K, which is the ratio of the field strength B_0 to the highest value B_{max} that is found at any point. The maximum always occurs at the midpoint of the inner radius of the coil. (auth)

17305 (ORNL-4367) X-RAY DIFFRACTION DATA ON AQUEOUS AMMONIUM HALIDE SOLUTIONS AT 25°C. Narten, A. H. (Oak Ridge National Lab., Tenn.). Feb. 1969. Contract W-7405-eng-26. 57p. Dep. CFSTI.

The scattering of x-rays from the free surface of aqueous ammonium chloride, bromide, and iodide solutions ($NH_4X \cdot \sim 8H_2O$) was measured and analyzed at 25°C. Both the raw data and the intensity and radial distribution functions derived from them are presented in tabulated form. The curves for the three solutions are compared with previously obtained results for ammonium fluoride solutions and for pure water at the same temperature. (auth)

17306 (ORNL-4380) PULSE CALORIMETRY USING A DIGITAL VOLTMETER FOR TRANSIENT DATA ACQUISTION. Kollie, T. G.; McElroy, D. L.; Barisoni, M.; Brooks, C. R. (Oak Ridge National Lab., Tenn.). Feb. 1969. Contract W-7405-eng-26. 33p. Dep. CFSTI.

A pulse calorimeter for measuring the specific heat of electrical conductors from 300 to 1500°K is described. The technique employed is unique in that a digital voltmeter, which is capable of recording 2000 readings/sec to a readability of 0.01% of full scale, is utilized to measure the transient temperature and power signals requisite to the method. Using this technique a calculated determinate accuracy of 99% has been achieved to 1200°K. Above 1200°K, the accuracy is at least 98%. Measurements of the spe-

cific heat of pure iron from 300 to 1500°K were repeatable to within ±0.5% and confirmed the above accuracy statements. The calorimeter is capable of measuring the specific heat and electrical resistivity rapidly at temperature intervals as small as 0.03 degree, and the significance of such capability is discussed, particularly with regard to the nature of the specific heat of iron near its Curie transformation. (auth)

17307 (ORO-2733-18) CHEMISTRY OF THE METALLOIDS OF GROUP VA AND GROUP VIA. Progress Report, January 1–December 31, 1968. Zingaro, Ralph A.; Irgolic, Kurt J. (Texas Agricultural and Mechanical Univ., College Station. Dept. of Chemistry). Jan. 27, 1969. Contract AT(40-1)-2733. 57p. Dep. CFSTI.

ANTIMONY—complexes with 0,0′-diethyl phosphorodiselenoate, ir spectral studies on bonding in
ARSENIC—complexes with 0,0′-diethyl phosphorodiselenoate, ir spectral studies on bonding in
—compounds of, preparation of R_2AsXR-type
ARSINE OXIDE, DIHEPTYLHYDROXY—physical properties of, x-ray powder diffraction studies on alternation of
ARSINE OXIDE, DIHEXYLHYDROXY—physical properties of, x-ray powder diffraction studies on alternation of
ARSINE OXIDE, HYDROXY—preparation of polymers containing groups of, for use as ion exchange resins
—preparation of substituted organic, reactions for
ARSINE OXIDE, HYDROXYDIOCTYL—physical properties of, x-ray powder diffraction studies on alternation of
ARSINE SULFIDE, TRIMETHYL—preparation of deuterated and normal, reaction scheme for
BISMUTH—complexes with 0,0′-diethyl phosphorodiselenoate, ir spectral studies on bonding in
CACODYL DISULFIDE—spectra of solutions of, in organic solvents, effects of temperature on NMR
CHALCOGENIDES—spectra of Group VA, ir
HYDROCHLORIC ACID—separation by solvent extraction using hydroxy-dioctylarsine oxide
INDIUM—complexes with 0,0′-diethyl phosphorodiselenoate, ir spectral studies on bonding in
ION EXCHANGE MATERIALS—preparation of polymers containing arsinic acid groups for use as
LEAD—complexes with 0,0′-diethyl phosphorodiselenoate, ir spectral studies on bonding in
PHOSPHORODISELENOIC ACID, 0,0-DIETHYL ESTER—complexes with nontransition elements, ir spectral studies on bonding in
POLYMERS—preparation of, containing arsinic acid groups for use as ion exchange resins
THALLIUM—complexes with 0,0′-diethyl phosphorodiselenoate, ir spectral studies on bonding in
TIN—complexes with 0,0′-diethyl phosphorodiselenoate, ir spectral studies on bonding in (P.C.S.)

17308 (RD/B/N-834) STRESS ANALYSIS BY THE FINITE ELEMENT DISPLACEMENT METHOD. Campbell, J. S. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Dec. 1968. 15p. Dep. CFSTI.

The general theory of stress analysis by the finite element method is described as a basis for subsequent reports on related computer programs. (UK)

17309 (SC-DC-67-2005) THERMALLY GENERATED STRESS WAVES IN A DISPERSIVE ELASTIC ROD. Percival, C. Mark (California Univ., Livermore. Lawrence Radiation Lab.); Cheney, James A. (California Univ., Davis). [1968]. 41p. (CONF-680544-1). Dep. CFSTI.

From Society for Experimental Stress Analysis, Albany, N. Y.

The propagation of thermally generated stress waves in a dispersive elastic rod was investigated both experimentally and analytically. In the experimental investigation, the end of a circular colored glass rod was heated very rapidly by the deposition of luminous energy from a Q-switched ruby laser. The light from the laser was directed parallel to the axis of the rod and deposited on the polished end of the rod. The depth of deposition was of the same order as the radius of the rod. The length of the energy pulse from the laser was 20 nsec. This resulted in heating at such a rate that it can be considered instantaneous when compared to the mechanical response of the material used. The resulting stress wave was measured using a thin quartz crystal in a Hopkinson pressure-bar arrangement. Love's modified wave equation was used to describe the motion. The thermoelastic problem was reduced to a homogeneous partial differential equation with appropriate initial and boundary conditions which is solved by the separation of variables technique. The experimental results are in good agreement with Love's theory. The amplitude of the stress waves was found to be directly proportional to the total energy deposited. The very short stress pulses generated by Q-switched laser deposition on the end of the thin rod gave rise to the higher modes of longitudinal wave propagation. The existence of wave propagation in a thin rod at near dilatational velocities was experimentally confirmed. It is concluded that the experimental techniques developed can be used to model stress wave generation due to electromagnetic energy depositions. Also, laser deposition provides an efficient means for generating the higher modes of longitudinal wave propagation in thin rods. (auth)

17310 (SC-RR-68-711) DATA ANALYSIS INVOLVING SOLUTION OF THE FREDHOLM INTEGRAL EQUATION OF THE FIRST KIND. Biggs, Frank (Sandia Labs., Albuquerque, N. Mex.). Feb. 1969. 107p. Dep. CFSTI.

A technique is developed and illustrated that uses information, e.g., estimates of measurement errors, which is supplemental to the actual data to obtain an improved mathematical description of the physical situation. The improved description then leads to better data analysis techniques, to means of making feasibility studies on experimental designs, and to methods of optimizing experimental parameters. (auth)

17311 (TID-24945) MAJOR ACTIVITIES IN THE ATOMIC ENERGY PROGRAMS, JANUARY–DECEMBER 1968. (Atomic Energy Commission, Washington, D. C.). Jan. 1969. 360p. GPO $1.75.

The atomic energy programs during 1968 sponsored by the U. S. Atomic Energy Commission are discussed. These include: radiation sources and nuclear byproduct materials, nuclear materials safeguards, nuclear defense, naval propulsion reactors, reactor development and technology, licensing and regulating the atom, operational and public safety, nuclear rocket propulsion, specialized nuclear power such as space electric power, terrestrial isotopic power, and isotopes fuel development, peaceful nuclear explosives, international affairs and cooperation, information and related activities, nuclear education and training, biomedical and physical research, industrial participation aspects, and administrative and management matters. (B.G.D.)

17312 (UCLA-10-P-14-51) GRAPH MODELS OF COMPUTATIONS IN COMPUTER SYSTEMS. Baer, J. L. (California Univ., Los Angeles. Dept. of Engineering). Oct. 1968. Contract AT(11-1)-Gen-10. 209p. Dep. CFSTI.

The problems of a priori scheduling and predicting of performance of computer programs on multiprocessor computer systems are investigated. The model used is a directed bilogic graph, drawn from FORTRAN source programs, where vertices represent computational tasks and arcs represent transfer of control and/or data. This model shows the precedence constraints, concurrency or mutual exclusiveness between subtasks. The directed bilogic graph is transformed, for analytical purposes, into a directed acyclic bilogic graph (d.a.b. graph) in such a way that the mean path lengths of the acyclic structures obtained by removing the feedback arcs are equal to the mean path lengths of the original structures when the latter are considered by themselves and not embedded in more complex structures. It is shown how this can be done either by measurements on the source program or by analytical methods. From the d.a.b. graph, mean path length measurements can be performed analytically or by Monte-Carlo methods. The path length measures combined with an algorithm examining the structure of the graph yield lower and upper bounds on the number of processors required for maximum parallelism in a homogeneous parallel processor system. Extensions of existing mean path length algorithms for homogeneous systems and investigations of procedures for other types of multiprocessors are given. Sampling has been performed in order to indicate the amount of distortion brought by these algorithms on five example graphs. A one-shot a priori scheduling with different urgency rules is presented. This algorithm was tested on example graphs with a wide range in the number of processors for these different urgencies. Experiments show that in general an a priori scheduling with urgencies, taking into account the global structure of the graph and the vertex attributes, behaves better (and never worse) than pure dynamic scheduling. The algorithms mentioned have been programmed in FORTRAN. The one-shot algorithm presents a large saving of computational time compared to previous experiments. (auth)

17313 (UCLA-10-P-14-61) PROBLEM ORIENTED LANGUAGE AND A TRANSLATOR FOR PARTIAL DIFFERENTIAL EQUATIONS. Cardenas, A. F. (California Univ., Los Angeles. Dept. of Engineering). Nov. 1968. Contract AT(11-1)-Gen-10. 248p. Dep. CFSTI.

The success and popularity of digital computer simulation languages is exemplified by the acceptability and success of languages such as SIMULA, GPSS and SIMSCRIPT to solve and study discrete system problems, and MIMIC, DSL/90, CSMP and

CSSL for continuous system problems characterized by ordinary differential equations. However, no high level problem oriented lems characterized by partial differential equations; furthermore, conventional methods to handle such problems on a computer are very time consuming and generally cumbersome. Therefore, two main goals are accomplished: (1) a convenient, easy to learn and to use, high level problem oriented language to solve and study partial differential equation problems is designed and (2) a feasible translator for the language is designed, and a working version of it is actually constructed for a significant portion of the language. The language, named PDEL for Partial Differential Equation Language, permits to: (1) clearly and conveniently specify the equation(s) (single or simultaneous), geometry, parameters, boundary conditions, etc., in Cartesian coordinates, and automatically obtain a solution using finite difference approximation algorithms; (2) specify any desired grid size to approximate the field; (3) conveniently terminate and repeat a simulation run with new parameters; (4) obtain a suitable tabular and/or discrete graphical print-out of the solution; and (5) specify PDEL statements in as free form as PL/1 statements, and in addition in any order. The language is oriented towards both batch and on-line processing, and it may be considered an extension of PL/1 since its syntax falls within the syntax of preprocessor or compile time PL/1. The translator is written in preprocessor PL/1 and translates from PDEL into PL/1. The PL/1 program generated is then processed like any other regular PL/1 program. The implemented PDEL is as much on-line as PL/1 is. The translator is machine independent; it is compatible and usable in any computer for which there is a standard PL/1 compiler. An evaluation of the version written for a significant portion of PDEL shows that its diagnostic capability is, or should be, at least as good as that of present day translators, and that its efficiency and speed is quite satisfactory. This should be true of future expanded versions of this translator implementing larger portions of PDEL. The main goal of the PDEL language and translator is to ease and speed up the total problem solving time, mainly by significantly reducing the programming effort—usually the largest portion of total program solving time. (auth)

17314 (UCRL-50541) A NEW POLYESTER-POLYETHER BINDER FOR EXTRUSION-CAST EXPLOSIVES. Bissell, Eugene R. (California Univ., Livermore. Lawrence Radiation Lab.). Nov. 5, 1968. 9p. Dep. CFSTI.

A binder for extrusion-cast explosives with the composition 70/19/7.2/3.6-bis(fluorodinitroethyl) formal–epoxide B–maleic anhydride–diethylene glycol was developed. Relative reactivities of a number of organometallic catalysts for the polymerization reaction are reported. (auth)

17315 (Y-1663) APPLICATION OF A DIGITAL COMPUTER TO MECHANICAL TESTING. Smith, J. H. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Feb. 27, 1969. Contract W-7405-eng-26. 26p. Dep. CFSTI.

A digital computer is being used to record raw data and to provide automatic data calculations for mechanical tests. The computer which is connected through an analog-to-digital converter to a universal testing machine and to a torsion tester, stores the raw load-strain data, converts it to stress-strain data, and calculates any of the mechanical properties desired from the test. The computer can also provide a printout and a paper tape, both of which contain the stress-strain data points and the calculated data. In addition, the load-strain data that are normally obtained from the test machine are still available. An oscilloscope display is obtained as the data are being recorded. Tests which are presently being performed using the computer are: tensile, compression, pin bearing, double shear, and torsion. Data, which are being recorded include: ultimate strength, offset yield strength, elastic and shear moduli, energy under the stress-strain curve, and a mathematical expression for the stress-strain curve. In addition to the mechanical load-strain curve provided by the test machine, the computer can provide a stress-strain curve and a listing of stress-strain data points. (auth)

17316 FUNDAMENTAL NUCLEAR ENERGY RESEARCH, 1968. A Supplemental Report to the Annual Report to Congress for 1968. Washington, D. C., Atomic Energy Commission, 1969. 391p. (TID-24945(Suppl.)). GPO $4.25.

The research programs of the U. S. Atomic Energy Commission during 1968 are discussed. The programs include reactor technology; nuclear safeguards; biological, medical, and environmental research; basic physical research in metallurgy, chemistry, high-energy physics, low and medium energy physics, controlled thermonuclear reactions, and mathematics. (B.G.D.)